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MINISTRY OF ENVIRONMENT, SPATIAL PLANNING AND ENERGY

SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

Nuclear and Radiation Safety in Slovenia
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Introduction

The Slovenian Nuclear Safety Administration (SNSA) has prepared a Report on Nuclear and Radiation Safety in Slovenia for 2001 as a regular form of reporting to the citizens of the Republic of Slovenia on the activities related to the nuclear fuel cycle and the use of the ionising sources. The report has been prepared in collaboration with the Health Inspectorate of the Republic of Slovenia (HIRS), the Administration for Civil Protection and Disaster Relief (ACPDR), the Pool for Assurance and Reinsurance of Liability for Nuclear Damage and the Pool for Decommissioning of the NPP Krško and for the Radwaste Disposal from the NPP Krško. The reports of the Agency for Radioactive Waste Management (ARAO), the Institute of Oncology, the Department of Nuclear Medicine of the Medical Centre Ljubljana and the technical support organisations are also included. The SNSA made no crucial modifications to the reports of the above mentioned institutions. The modifications were made just facilitate a reading of the reports.

The State of Radiation and Nuclear Safety in Slovenia

1. The Krško Nuclear Power Plant (The NPP Krško)

The SNSA pays special attention to radiation and nuclear safety, especially to the high level of safety in the NPP Krško, including control over modifications and changes in the plant. Changing of the facility project basements or the conditions under which the nuclear facility operates is one of the main parameters which can determine the safety of and the control over the facility. The SNSA issued 29 decisions to the NPP Krško in the year 2001. In addition, it issued 9 documents concerning the main technical modifications proposed by the NPP Krško. The main modifications in the year 2001 related to the protection of the reactor coolant system against increase of pressure at low temperatures, the system for detection of impurities in the reactor coolant system and the assembling of fire detectors in the area of the low and intermediate radioactive waste drying system.

In 2001, the operation of the NPP Krško was safe and stable. In the Republic of Slovenia the share of the nuclear energy production was 38.98 %. In the same year the production of electrical energy of the NPP Krško was the highest compared to all other years of its operation. It reached 5 milliard kWh in spite of the fact that the power plant had to operate occasionally at lower power, due to the low water flow of the Sava river or due to administrative restrictions related to the increase of temperature of the river water. The production was 0.27 % below the plan. The availability factor and the load factor were 88.94 % and 87.64 % respectively. No unplanned manual or automatic reactor shut-down was performed in the year 2001.

The power plant was stopped only during the outage, with duration of only 2/3 of the average duration of outages in the last several years, so that it was one of the shortest in these years. During the outage, 36 fuel elements were replaced, so that altogether 630 fuel elements were placed in the fuel pool at the end of the year 2001. During the outage, visual and radiographic inspection of the Reactor Coolant Pump No. 2 Housing, Control Rod Guide Tube Support Pins replacement, regenerative heat exchanger replacement and replacement of the main transformer took place. In 2001, 217 drums were filled with solid low and intermediate level radioactive waste, so that the accumulated amount of the volume of low and intermediate level radioactive waste at the NPP Krško was 2208 m^3.

In 2001, 887 workers received the total collective dose of 1.13 man Sv, which is close to the world-wide average annual collective dose for this model of power plants between the years 1998 and 2000, which is 0.98 man Sv. The main reason for the reduction of the collective dose at the NPP Krško in 2001 lies in the modernisation of the plant which was finished in the year 2000. The average annual effective dose was 1.27 mSv and the maximum individual effective dose was 15.81 mSv, which is 32 % of the dose limit according to the legislation and 79 % dose limit according to the European Union limit. 81 % of the collective dose at the NPP Krško was received by contract workers, (the average annual effective dose of these workers was 1.71 mSv), while the average effective dose of the permanent staff at the power plant was 48 % of the total average dose.

The inspection of the influence of operation of the power plant on the environment was performed according to the programme. The gas and liquid releases were controlled. The activity of tritium liquid releases reached 38.8 % of the limited value, while the activities of other radioisotopes in the liquid releases were a few thousand times lower. In the gas releases, the main radionuclides are the noble gases. Their activities in the releases are very low. None of these radionuclides exceeded 2 % of the limited activity. This is in compliance with the fact that no fuel degradation in the fuel core was observed.

2. The TRIGA MARK II Research Reactor at Brinje

The TRIGA MARK II Research Reactor at Brinje, which operates at the Reactor Centre at Brinje of the Jožef Stefan Institute (JSI), is used mainly for experimental work. In 2001, it operated 165 days, with 43 workers participating in its operation. The annual collective dose of the reactor operators, researchers and radiation protection professionals at JSI was 1.96 man mSv. The total number of fuel elements in the core was 56, while 38 fuel elements were in the fresh fuel storage. In 2001, modernisation of the Pneumatic Post System was performed, financed by the International Atomic Energy Agency (IAEA).

3. The Central Interim Storage for Radioactive Waste at Brinje

Since the year 1999, the manager of the Central Interim Storage for Radioactive Waste at Brinje is ARAO. At the end of the year 2001, 254 drums of low and intermediate radioactive waste were stored in the storage, together with 520 other radioactive waste sources. Seven sources were stored in the year 2001. The Austrian Research Centre from Seibersdorf performed the treatment of the radium sources which were already stored in the storage, as well as those which were stored by that time at the three users in Slovenia. The treatment was sponsored by the IAEA. In 2001, the ARAO performed reconstruction of hydroinsulation based on the decision issued by the Ljubljana Administrative Office of the Ministry of Environment and Spatial Planning. The order was based on the construction legislation and it did not take into account the nuclear legislation. The legislative procedure related to the issue of that decision is not finished yet.

4. The Žirovski vrh Uranium Mine

In 2001 the RŽV d.o.o. (RŽV) performed the renovated programme “Permanent Cessation of Exploitation of the Uranium Mine and Prevention of Consequences of Mining”, based on two amendments of the “Operational Plan of Activities for the Year 2001”, adopted by the Government in the year 2001. The prepared activities related to acquirement of a loan at the European Investment Bank (EIB), which included also assessment of the technical solutions of the cessation of exploitation and compliance of such solutions with the Slovenian and European legislation. Based on the proposal of the EIB, the Wismut GmbH revised the above mentioned programme. The revision should give valuable information to the EIB and the Ministry of Environment and Spatial Planning concerning the adequacy of the proposed programmes of restoration of the Žirovski vrh Uranium mine. Special attention was given to long term stability of the disposal sites Jazbec and Boršt with the residual radioactive waste.

The control of emission from the site was performed in compliance with the programme. No activities which could change the emission from the site took place in the year 2001. The number of exposed workers has been approximately the same in the last few years; the average annual effective dose was 1.3 mSv, or less than 3 % of the dose limit of Slovenian legislation, and 6.5 % of the dose limit in the European Union. The maximum annual effective dose was 2.95 mSv.

5. Inspection Control

The inspectors of the SNSA carried out 84 regular and one exceptional inspection at the NPP Krško. In addition, they were present during the arrival of new fuel for the NPP Krško at the Port of Koper. As in 2000, the SNSA inspectors were permanently present at the NPP Krško site during the outage, so the information flow between the NPP and the SNSA was improved, as well as the efficiency of problem solving when these occurred.

At the TRIGA MARK II Research Reactor two inspections were performed by the SNSA inspectors in the year 2001. 29 inspections were carried out at the Central Interim Storage for Radioactive Waste at Brinje or at the ARAO, which is substantially more than the year before, when only three inspections were performed. This increase was mainly due to the reconstruction of the storage. One inspection was carried out at the RŽV, focusing on inspection of the documentation related to uranium and uranium dioxide quantities and on assessment of the site of the technological installations.

Radiation Protection in the Living Environment

Radiation protection of population in the Republic of Slovenia is based on the measurement of radioactivity in the environment. It is composed of three different systems:

- Central Radiation Early Warning System for immediate detection of increase of radiation on the territory of the Republic of Slovenia due to a potential nuclear or radiation accident in the country or abroad,
- Global Radioactivity Contamination Monitoring Programme in the living environment on the territory of the Republic of Slovenia, including the control of surface water, air, ground, precipitation, drinking water, food and fodder,
- Radioactivity Monitoring in the environment of the NPP Krško, TRIGA MARK II Research Reactor at Brinje, the Central Interim Storage for Radioactive Waste at Brinje, and monitoring of environment at the Žirovski vrh Uranium Mine.

In Europe, automatic monitoring of increase of radiation on the territories of individual countries and systems for the exchange of relevant data were developed intensively after the accident in Chernobyl in 1986. After 1996, the Central Radiation Early Warning System of Slovenia (CROSS) was developed at the SNSA, which includes real-time measurement data of external radiation on the territory of the Republic of Slovenia. The Radiation Early Warning System is a complex system. It enables control over increase of radiation on the territory of Slovenia, including measurement of external radiation based on probes, automatic monitoring of the aerosol radioactivity of air based on three monitoring probes, automatic measurements of radon progeny concentration in the environment of the Žirovski vrh Uranium Mine, and radioactive deposition measurement at the Ljubljana site.

The basic scope of the Global Radioactive Contamination Monitoring Programme of the environment was not changed in 2001. The technical support organisations, JSI and the Institute of Occupational Safety (IOS), which measure global contamination, reported that the specific activity of artificial radionuclides in air, water and food was less than 1 % of the limited concentrations for the population. The effective annual dose due to ingestion of artificial radionuclides was assessed to be 4 micro Sv and it can be compared with the assessed doses in the neighbouring countries. The assessed annual effective dose due to external radiation in the Republic of Slovenia is somehow higher than in these countries, reaches about 50 micro Sv.

The regular continuous monitoring of the NPP Krško includes monitoring of radioactive liquids and gaseous emissions at the source as well as independent monitoring of radioactivity in the environment. In 2001, the first part of monitoring was provided by the NPP Krško, including comparative measurements of the technical support organisations, while the second part was performed by the JSI and the IOS. The assessed annual dose to the adult from the neighbouring population of the Krško NPP was 13.0 micro Sv, while the dose to the child was assessed to be 15.8 micro Sv, mainly due to the submersion and deposition.

In 2001, the regular monitoring of the RIC was conveyed according to the programme. The main contribution to the dose was due to the releases of the radionuclide Ar-41 in air, while minor contribution can be attributed to the liquid releases. The assessed effective dose to the population was less than 0.03 % of the dose limit.

The programme of regular monitoring of the Central Interim Storage for Radioactive Waste at Brinje was based on the decision of the SNSA and performed by the JSI and the IOS in full scope in 2001. The assessed annual effective dose to the member of public inside the controlled territory of the storage was less than 0.8 % of the dose limit, while farmers working outside this territory received 0.03 % of the dose limit.

Regular monitoring of radioactivity in the environment of the RŽV has been conveyed for around 15 years. During the stage of closing the mine, the radon emission in the liquid releases decreased. For the first time, lower concentration of radon and other radioisotopes in some samples was detected in 2001. The assessed annual effective dose due to the presence of the RŽV was 0.23 mSv. Radon and its daughters contributed 75 % to the dose. The assessed annual effective dose due to the past activities of the RŽV was 4 % of the average annual effective dose due to the natural radioactivity in that environment.

Radiation Protection in the Working Environment

The HIRS inspectors inspect the implementation of the laws and regulations in the field of ionising radiation. In 2001, the HIRS decreased the number of inspections compared to the year 2000, so that only 40 were carried out. Six inspections and one technical survey were performed at the Krško NPP, three inspections were performed at the JSI, and two at the ARAO.

During the inspection at the Central Interim Storage for Radioactive Waste at Brinje, concerning the reconstruction of the hydroinsulation, it was found that the outside workers did not enter the storage during their work, that their health was not in danger and that they were familiar with the danger of the ionising sources at the site. Regarding radiation protection at the storage, the HIRS issued a decision in October 2000, stating that ARAO had to prepare a programme which would be implemented with the help of the technical support organisations. It was also stated that it should be assessed by the Nuclear Safety Expert Commission. The ARAO sent a complaint to the Ministry of Health which decided that the decision was in compliance with the legislation. The ARAO then sent the complaint to a higher legislative level.

The HIRS continued with the inspection at the RŽV and other objects concerning higher concentration of radon and radon daughters. Three inspections were performed at RŽV and one technical survey. One inspection was carried out at the Mežica Lead and Zinc Mine. The monitoring of the JSI in kindergartens and schools with increased values of radon also continued, so that monitoring was performed in all objects where concentration of more than 400 Bq/m^3 was measured. The JSI conveyed the programme of assessment of doses in ten water supply enterprises.

In 2001, the HIRS carried out 7 inspections in medical institutions. The development of the A record of the sources in human and veterinary medicine was made, and altogether 696 X-ray devices were identified. Seven clinics and hospitals use unsealed sources for diagnostics and therapy. In the Republic of Slovenia, two large radiotherapy units were established. The Institute of Oncology uses unsealed sources as well as sealed sources and accelerators. In 2001, the Institute of Oncology stopped using one of the three radiotherapy accelerators due to its deficiencies and the mounting of a new one started in that year. Besides the Institute of Oncology, the Department of Nuclear Medicine of the Medical Centre Ljubljana is the second relatively large radiotherapy institution in Slovenia. At this department, 447 radiotherapy procedures were carried out in 2001. The HIRS found that, although a decision was issued to this clinic in 1995, demanding a closed system for the control of radioactive liquid releases in the environment, the system was still not built.

In 2001, the HIRS inspectors performed 12 inspections at industrial enterprises, where 577 sealed sources and 1103 X-ray devices were recorded.

The SNSA continued with the development of a Computerised Registration System of Occupational Exposure in a Nuclear Fuel Cycle in Slovenia, in accordance with the directives 96/29/Euratom and 90/641/Euratom.

In 2001, an expert inspection of activities related to the use of ionising sources in the Republic of Slovenia was performed by two technical support organisations, namely the IJS and the IOS:

- The experts from the IOS carried out 680 inspections of radioactive sources at medical institutions in 2001. They found out that at around 62 % diagnostic devices no defects were found, but at approximately 22 % the devices either needed servicing or should even be put out of use. In industry, more than 280 inspections of sources of ionising radiation were carried out. Besides the dose control of more than 3000 persons, the IOS also performed training of more than 500 persons concerning safe use of ionising sources in 2001. It also carried out a project concerning the exposure of patients due to common X-ray examinations in the General Hospital Maribor, which was financed by the HIRS.
- Experts of the JSI issued in 2001 more than 280 certificates and reports related to the routine calibrations of instruments which are used in radiation protection. Intercomparison of TL dosimetric services was also performed in 2001.

In 2001, the majority of medical examinations related to the health surveillance of workers with ionising sources were performed by three authorised institutions: Aristotel d.o.o., the Institute of Occupational, Traffic and Sports Medicine of the Medical Centre Ljubljana, and the IOS, which performed altogether more than 2300 medical examinations.

Radioactive Material

The transport of radioactive material was performed in compliance with the Act on Transportation of Dangerous Goods except in three cases:

- The radioactive source Co–60 with assessed activity of 80 MBq was melted in the steel factory Acroni Jesenice unintentionally. The source came to Slovenia in a shipment of scrap metals from abroad. After the melting the steel factory discovered contamination of the stainless steel.
- The transport of a lightning rod with radioactive source Eu-152/154 between Grosuplje and RIC was not done according to legislation. The lightning rod was also not disassembled and stored in compliance with legislation. The doses received by the workers who performed these jobs were not above the dose limits but the event shows deficiency in radiation protection. The lightning rod is stored in the Central Interim Storage for Radioactive Waste at Brinje.

- In 2001, Italian customs officers did not allow a railway carriage loaded with scrap metals from Slovenia to enter Italy due to the radioactive orphan source Eu-152/154 which was stored in the carriage. The source is now stored in the Central Interim Storage for Radioactive Waste at Brinje.

At the last two interventions, the Ecological Laboratory with a Mobile Unit was used.

In 2001, the import and export of the radioactive and nuclear material were performed in compliance with the Decree of Import and Export of Specific Goods.

Physical Protection of Nuclear Material

In compliance with the Treaty on the Non-proliferation of Nuclear Weapons and the Safeguards Agreement, seven inspections of IAEA experts were performed at the NPP Krško in the year 2001. In that year, the SNSA started with the control of nuclear material at small users of this material. It also participated in IAEA activities concerning the Protocol Additional to the Safeguards Agreement. In 2001, the IAEA inspectors inspected the NPP Krško for the first time without any preceding notice. The inspection was carried out in compliance with the Protocol Additional to the Safeguards Agreement.

In the Republic of Slovenia, the Law on Export of Dual-use Goods has been put into force. The Ministry of Economic Affairs established an informal group of experts on management of transport of such goods in order to improve the control of export, import and use of dual-use goods. Physical protection of nuclear installations was conveyed in accordance with the legislation. Inspections were performed by inspectors of the SNSA and the Ministry of Internal Affairs. The Ministry of Internal Affairs amended the "Design Basic Threat of Nuclear Facilities in the Republic of Slovenia", so that assessment concerning the Central Interim Storage for Radioactive Waste at Brinje is also included in the document.

Disposal of Radwaste

Due to the delay in the refurbishment of the Central Interim Storage for Radioactive Waste at Brinje, the public service for radioactive waste is not fully operable. It is operable only in the case of intervention. The document entitled "A Proposal on the Strategy of Low and Intermediate Level Radioactive Waste Management", which was prepared in 2000 by the ARAO, was still not adopted by the Government in 2001. In that year the Ministry of Environment and Spatial Planning started reconsidering the decommissioning plan for the NPP Krško.

Emergency Preparedness

In 2001, the ACPDP, the NPP Krško and the SNSA performed activities related to the "National Nuclear Emergency Response Plan". A one-day exercise, called "NPP Krško - 2001", related to that plan was performed. All workers from the NPP Krško and the SNSA took an active role in the exercise. A two-year project entitled "Strengthening of Regional Emergency Preparedness", under the auspices of the IAEA, started in the year 2001, including Slovenia as a participant. In the year 2001, the representatives of a joint group of the Republic of Croatia and the Republic of Slovenia met in order to harmonise the emergency plans of both countries. At an international exercise "Joint International Nuclear Emergency Exercise" (JINEX-2000), which was supported by the OECD/NEA, the commander of the Civil Protection of the Republic of Slovenia, the headquarters of the Civil Protection of the Republic of Slovenia in operational set-up, the ACPDP, the SNSA and representatives of the ministries responsible for specific parts of the above mentioned emergency plan participated. In 2001, the SNSA continued with the preparation of implementation of the European Union programme RODOS, which concerns optimisation of activities concerning nuclear or radiation emergency.

The Slovenian Nuclear Safety Administration

In 2001, the number of staff of the SNSA was 44. The adopted budget was 409,127,000 SIT.

1. Legislation

The Government of the Republic of Slovenia adopted the Decree on the Limitation of the Operator Liability in the Field of Nuclear Energy and the Insurance Sum in the Field of Nuclear Energy. In 2001, the Ministry of Environment and Spatial Planning formed a group of representatives from different ministries with the task to prepare a new law concerning radiation and nuclear safety. The law should replace the two existing laws in this field and should be in line with the legislation of the European Union.

In 2001, the Republic of Slovenia ratified the Paris Convention on Third Party Liability in the Field of Nuclear Energy, which regulates the system of liability and insurance for nuclear damage. The ratification of this convention is of great importance for the Republic of Slovenia considering that Slovenia is the first state outside the OECD countries which has ratified the convention. In 2001, the Republic of Slovenia also ratified the Brussels Supplementary Convention of 31 January 1963, which supplements the Paris Convention.

In compliance with the Nuclear Safety Convention, the Republic of Slovenia prepared the national report in 2001, which was sent to the IAEA.

In the year 2001, Slovenia ratified the agreement between the SNSA and the National Office for Nuclear Safety Administration of the Czech Republic on exchange of information related to nuclear safety, safeguards and radioactive waste management, and to the location, construction, operation, management and decommissioning of nuclear installations.

2. Co-operation with the IAEA

The main activities of the SNSA related to the IAEA mission were as follows:
- A delegation of the Republic of Slovenia took an active part in the 45th General Conference.
- Representatives of the SNSA participated in the Board of Governors meetings.
- Representatives of the Republic of Slovenia took part in the seminars and conferences organised by the IAEA, which also sent fellowship holders to the SNSA. In addition, the Republic of Slovenia participated in several technical assistance projects.

The following missions took place in the Republic of Slovenia in the year 2001:
a. periodic safety review mission at the NPP Krško,
b. emergency preparedness safety review at the NPP Krško,
c. the occupational radiation protection appraisal service (ORPAS) at nine institutions in Slovenia, including the HIRS and the SNSA.

3. Co-operation with the European Union

The EURATOM Treaty, together with the regulations stipulated by it, forms a regulatory framework which is binding for each Member State of the European Union. This framework comprises nuclear safety, radiation protection, research, safeguards, supply of nuclear materials, external relations and peaceful use of nuclear energy. It is equally binding for the Candidate States and the Member States. In the negotiations between the Republic of Slovenia and the European Union, the fields “Energy” and “Environment” were closed in the year 2001, so that additional negotiations were not necessary.

The Board of the European Union discussed the "Nuclear Safety Report in the View of the Enlargement of the European Union" prepared by the *Working Party on Nuclear Safety* (WPNS). The main comment concerning the Republic of Slovenia related to the nuclear legislation which was in the preparation phase for a long time. The European Union advised quick finalisation of this legislation. Also advice related to the seismic characteristics of the area of Krško Polje were given, the budget and the staff capabilities of the regulatory body, and the emergency preparedness including updating of the "National Emergency Response Plan".

The SNSA also took part in the activities of the group called 'the *CONCertation on European Regulatory Tasks'* (CONCERT), which consists of nuclear safety regulatory bodies form the European Union Member States and the Central and Eastern European Countries, and countries of the former Soviet Union. The SNSA also participated in the *Nuclear Regulators' Working Group* (NRWG), which is an advisory body of the *European Commission* (EC), and in activities of the *European Nuclear Installation Safety Group* (ENIS-G). Besides these activities, the SNSA also took part in the *European Radioactive Waste Regulators' Forum* (ERWG), which is an informal society of representatives of regulatory bodies in the field of nuclear and radiation safety. The SNSA also participated in some other formal groups established by the EC.

The communication between the *European Community for Urgent Radiological Information Exchange* (ECURIE) programme and the SNSA was established in 2001. The ECURIE was developed due to the need for an organised communication system between the European Union members. The system is available 24 hours per day and can accept the first information related to a nuclear accident, start the alarm in case of emergency and send appropriate information to competent authorities. The Republic of Slovenia was the first country of the Candidate States which established communication with the ECURIE programme.

The SNSA took part in activities of the *European Union Radiological Data Exchange Platform* (EURDEP), which enables radiological data exchange based on on-line monitoring of external gamma radiation and automatic monitoring systems of more than 20 European countries. The SNSA was also active in the project *Applicant Country Co-operation with the Euratom Safeguards System* (ACCESS), which is considered to be a suitable system for reporting of nuclear material owners in the Candidate States to the European Union.

4. Other international co-operation

Besides the above mentioned co-operation, representatives of the Republic of Slovenia also participated in activities of the association called *Western European Nuclear Regulators' Association* (WENRA), in which representatives of the regulatory bodies of West European States are associated. Representatives of the Republic of Slovenia also took part in the *Network of Regulators of Countries with Small Nuclear Programmes* (NERS), which is an association of representatives from regulatory bodies in countries with small nuclear programmes. The SNSA also participated in a conference of the *International Nuclear Law Association* (INLA).

5. Co-operation with the OECD/NEA

In December 2000, the Republic of Slovenia sent a formal application to the *Nuclear Energy Agency* (NEA) to become an observer in the seven OECD/NEA committees. The NEA is an independent organisation within the *Organisation for Economic Co-operation and Development* (OECD). On December 20, 2001, the Board of the OECD confirmed the acceptance of the Republic of Slovenia in all seven committees.

6. Bilateral agreements

In 2001, various activities related to the bilateral agreements between the Republic of Slovenia and the Czech Republic, the Republic of Austria, the Republic of Croatia, the Republic of Hungary and the Slovak Republic took place.

7. Expert commissions

The Nuclear Safety Expert Commission (NSEC) met five times in the year 2001 and discussed topical expert issues. The Expert Commission for Operators Exams met three times in the year 2001. It organised exams for reactor operators which were successfully completed by 11 candidates.

Pool for Assurance and Reinsurance of Liability for Nuclear Damage and Pool for Decommissioning of the NPP Krško and for Radwaste Disposal from the NPP Krško

In 2001, the NPP Krško did not report any nuclear damage to the Pool for Assurance and Reinsurance of Liability for Nuclear Damage**.**

All financial obligations of the NPP Krško to the Pool for Decommissioning of the NPP Krško and for Radwaste Disposal from the NPP Krško were paid in compliance with obligations related to the production of electric energy in the power plant in 2001.

Operation of Nuclear Facilities World-wide

In 2001, 440 nuclear power plants operated in the word. The largest number, that is 118, in North America, and the smallest number in Africa, where only two power plants existed in that year. The number of nuclear power plants increased by two in the year 2001 and 32 power plant were under construction. Altogether 133 states were part of the IAEA and 58 national and other organisations had an agreement or treaty with it.

The IAEA information system – the *International Nuclear Event Scale* (INES) received 23 reports in 2001, 15 of these were connected to operation of nuclear power plants, the others were related to the orphan sources (3 reports), accidents with a radioactive source (3 reports) and events related to transport of sources (2 reports). Six of the events in nuclear power plants were determined to be accidents of Level 2, 4 were determined to be irregularities of Level 1, and 5 were determined to be of Level 0. The other events were: two events of Level 2, five events of Level 1 and one event of Level 0. The Republic of Slovenia did not report to the INES in 2001.

In 2001, seven nuclear power plants reported to the *"Incident Reporting System"* of the IAEA. Two of them were related to the nuclear power plants in Germany and France and showed deficiencies in nuclear safety in these power plants.

Conclusions

In 2001, the regulatory bodies of the Republic of Slovenia regularly performed the control over the operation of nuclear facilities, transportation and storage of nuclear and radioactive materials, medical use of the ionising sources, use of radioactive sources in industry and in institutions in the fields of research, education and veterinary medicine, and control of emergency preparedness. Regarding these activities and the process of Slovenia's accession to the European Union, the regulatory bodies conclude that future activities should focus on preparation of new legislation in the field of radiation and nuclear safety in the Republic of Slovenia.

1 INTRODUCTION

The Slovenian Nuclear Safety Administration (SNSA) prepares a Report on Nuclear and Radiation Safety in Slovenia every year as a regular form of reporting to the citizens of the Republic of Slovenia on the activities related to the nuclear fuel cycle and the use of the ionising sources. The report also includes a description of the activities related to the process of Slovenia's accession to the European Union and the co-operation of the Republic of Slovenia with other countries and international organisations in the field of nuclear and radiation safety. The report regarding the operation of nuclear facilities in the world is also a part of the report.

Chapter II concerns the nuclear safety of the Krško Nuclear Power Plant, TRIGA MARK II Research Reactor at Jožef Stefan Institute, Central Interim Storage for Radioactive Waste at Brinje and the activities related to the Žirovski vrh Uranium Mine. Chapter III deals with radiation protection in the living environment, with an emphasis on the contamination of the environment due to the use of nuclear energy and ionising sources in the Republic of Slovenia and abroad. The doses of the population due to this contamination are discussed. Chapter IV describes radiation protection in the working environment and control over the medical use of ionising sources. The whole report of the Health Inspectorate of the Republic of Slovenia is included in this chapter. Chapter V explains the comprehensive control over transport, import and export of radioactive and nuclear material, the system of non-proliferation of nuclear weapons and physical protection of nuclear material in the country.

The radioactive waste management in the Republic of Slovenia is dealt with in Chapter VI, which is followed by Chapter VII, discussing the emergency preparedness. This chapter was prepared in collaboration between the Administration for Civil Protection and Disaster Relief and the SNSA. Chapter VIII provides a detailed description of activities of the SNSA, its organisational chart and responsibilities. It is followed by a report on the activities of the authorised organisations in the field of nuclear and radiation safety. In Chapter X, a description of the system concerning liability for nuclear damage is given and in Chapter XI the activities of the Pool for Decommissioning of the NPP Krško and for Radwaste Disposal from NPP Krško are described.

Chapter XII gives a short description of the operation of nuclear facilities in the world, the activities of the International Atomic Energy Agency and of unusual events related to the operation of nuclear facilities in the world in the year 2001.

As mentioned above, the report has been prepared in collaboration with the Health Inspectorate of the Republic of Slovenia (HIRS) and the Administration for Civil Protection and Disaster Relief (ACPDR). The reports of the Agency for Radioactive Waste Management (ARAO), the Department of Nuclear Medicine of the Medical Centre Ljubljana, the Institute of Oncology, the Pool for Assurance and Reinsurance of Liability for Nuclear Damage and the Pool for Decommissioning of the NPP Krško and for Radwaste Disposal from the NPP Krško are also part of this report, as well as the reports of the authorised organisations in the field of nuclear and radiation safety, namely: Aristotel d.o.o., the Faculty of Electrical Engineering and Computing - University of Zagreb, the Faculty of Mechanical Engineering – University of Ljubljana, Milan Vidmar Electric Institute, ENCONET Consulting Ges. m.b.H., IBE Consulting Engineer, the Energy Institute Ltd., the Institute for Energy and Environmental Protection – EKONERG, Jožef Stefan Institute, the Institute of Occupational, Traffic and Sports Medicine of the Medical Centre Ljubljana, the Institute of Metals and Technologies, the Institute of Metal Construction, the Welding Institute, the Institute of Civil Engineering and the Institute of Occupational Safety.

The SNSA would like to express its gratitude to all the collaborators. The SNSA made no crucial modifications to the reports of the above mentioned institutions. Some modifications were made only in order to facilitate reading of the reports.

In spite of our effort to avoid duplication of specific themes, some topics are described at different parts of the text due to the fact that they are connected to activities of more than one institution. As a rule, reference to such parts of the text is given where necessary.

To meet the readers' demands, this report does not give only general data about activities concerning nuclear and radiation safety in the Republic of Slovenia but also considerable details on specific related subjects. The reader requiring only a brief overview of the topics discussed in the report is invited to read only the Summary, which offers only the most important basic facts and data. On the other hand, the Summary is intended to raise the reader's interest in the more comprehensive discussion of these topics, provided in the report by experts from the above mentioned institutions.

All readers are kindly invited to send comments regarding this report to the address of the SNSA (SNSA, Železna cesta 16, Ljubljana) or to send an e-mail (SNSA@gov.si). We shall be most grateful for all comments and suggestions.

2 NUCLEAR SAFETY IN SLOVENIA

2.1 THE KRŠKO NUCLEAR POWER PLANT

2.1.1 OPERATIONAL SAFETY

2.1.1.1 Operational and safety indicators

In 2001, the Krško NPP generated 5,257,087.5 MWh (5.2 TWh) of electrical energy at the output of the generator, or 5,036,275 MWh (5.0 TWh) net. This is the highest production of electrical energy in one year in the whole operation history of the Krško NPP. The generator was connected to the electrical grid for 7,821.53 hours or 89.29 % of the total number of hours in the year. The production of electrical energy was within the plan in spite of periodically being below 100 % power operation because of low Sava river flow (administrative limitation of heating external medium in the spot of mixing). The generation of thermal energy in the Krško NPP reactor was 14,947,028 MWh. The total production of electrical energy in Slovenia has been increasing in the last several years and was 12,904.2 GWh in the year 2001. The nuclear share of the energy production in Slovenia increased to 38.98 %. The most important safety and operational indicators are shown in Tables 2.1, 2.2 to 2.3, while their changes over several years are presented further in the report. The most important performance indicators confirm that the operation of the Krško NPP remains stable and safe.

Table 2.1: Safety and operational indicators of the Krško NPP in 2001.

Safety and Operational Indicators	Year 2001	Average
Availability factor [%]	88.94	82.69
Load factor [%]	87.64	78.96
Forced outage factor	0	1.36
Net electrical energy production [GWh]	5,036.27	4,287.02
Reactor trips - automatic [Number]	0	3.48
Reactor trips - manual [Number]	0	0.27
Reactor shutdown - unplanned normal [Number]	0	1.16
Reactor shutdown – planned normal [Number]	1	0.74
Incident reports [Number]	2	3.95
Outages duration (Days)	40.38	55.65
RCS contamination – cycle 17 – primary circuit (g. Uranium)	1.3	9.22
Fuel reliability indicator (FRI) [GBq/m^3]	0.0017	0.12

Figure 2.1 presents the gross energy produced at the Krško NPP in 2001, Figure 2.2 presents the monthly produced energy for August 2001 (as an example) showing the reduction of power because of lower flow of the Sava river. Due to the NPP's reliable operation in 2001, the electrical production of the Krško NPP was only 0.27 % lower than planned, despite the longer 2001 outage (unplanned inspection of the welds of the reactor pressure vessel nozzle).

Table 2.2: Schedule of planned and realised production in the Krško NPP in 2001.

Month	Planned production [GWh]	Actual production [GWh]	Difference [%]
January	505.7	505.763	0.01
February	455.1	455.184	0.02
March	498.6	503.268	0.94
April	400.0	427.821	6.96
May	82.7	96.710	16.94
June	168.1	170.715	1.56
July	487.3	483.244	-0.83
August	482.0	446.934	-7.28
September	480.1	476.561	-0.74
October	502.2	503.383	0.24
November	486.0	487.128	0.23
December	502.2	479.564	-4.51
Total	5,050.0	5,036.275	-0.27

Table 2.3: Analysis of operation of the Krško NPP in 2001.

Analysis of operation	Hours	Percentage [%]
Number of hours in a year	8,760.00	100.00
Operation of the NPP (in the grid)	7,790.75	88.94
Duration of shutdowns	969.23	11.06
Duration of annual outage	969.23	11.06
Duration of planned shutdowns	0	0
Duration of unplanned shutdowns	0	0

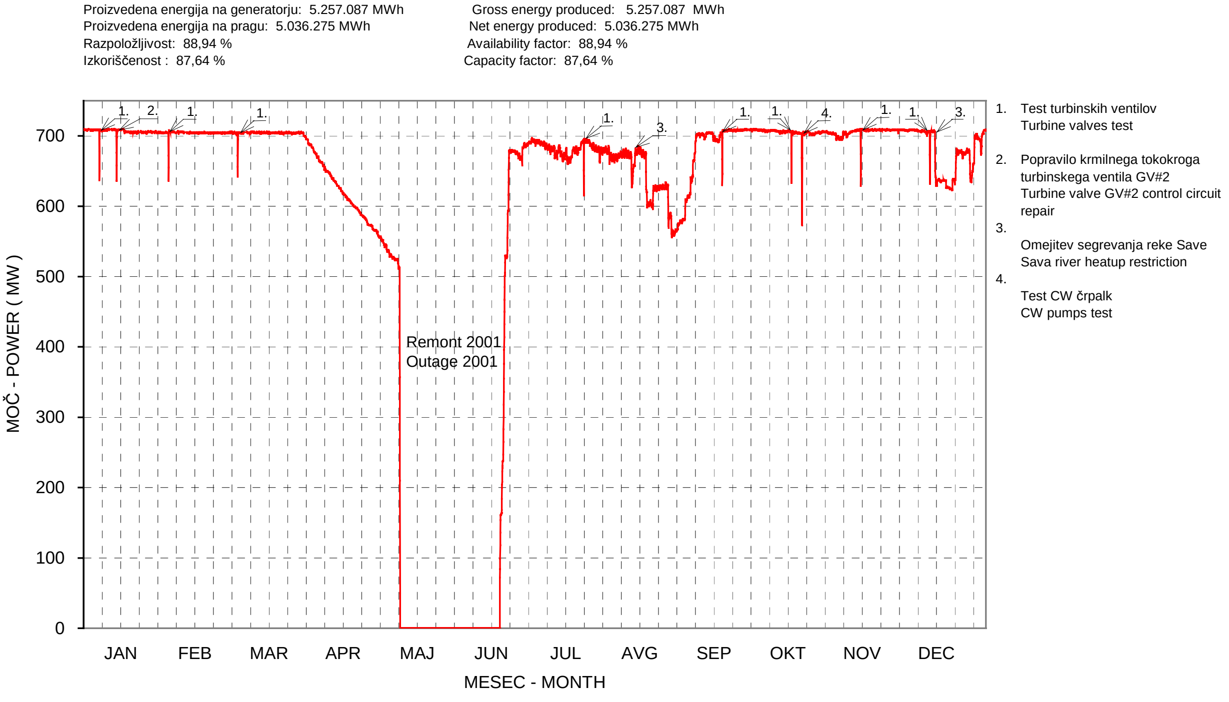

Figure 2.1: Time diagram of energy production in the Krško NPP for 2001.

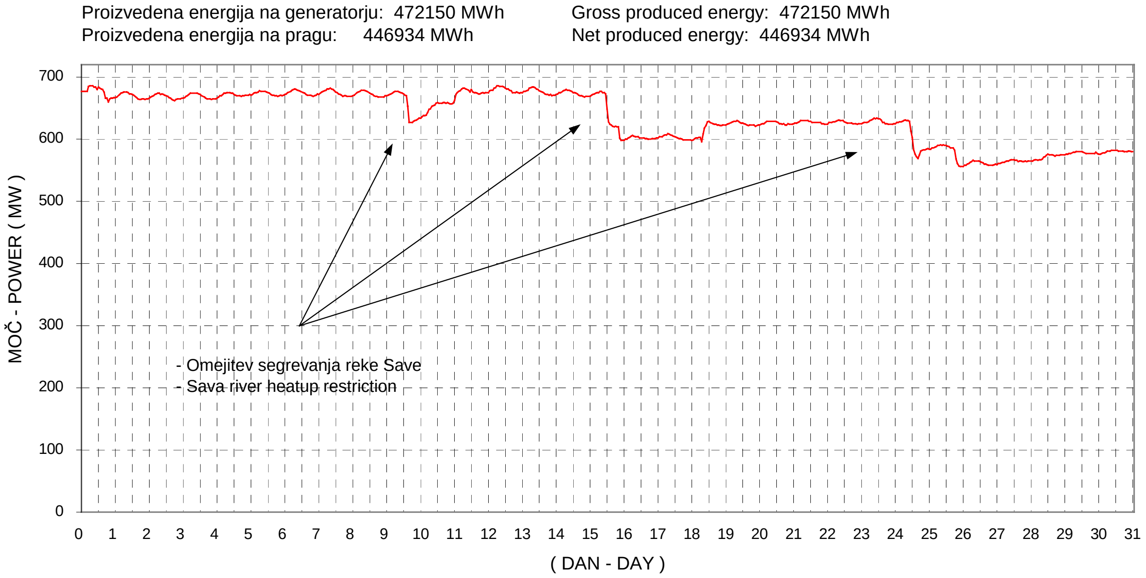

Figure 2.2: Time diagram of energy production in the Krško NPP for August 2001.

Figures 2.3, 2.4., 2.5 and 2.6 present charts showing the number of reactor shutdowns per year. More information about the Krško NPP reactor shutdowns and power reductions is given in section 2.1.1.2. Figures 2.7 and 2.8 present charts showing the forced outage factor and the number of incidents per year.

In addition to a high production and load factor, also the operation reliability of the Krško NPP was at a very high level. In 2001, there were no abnormal events or automatic shutdowns. A planned manual shutdown took place during the 2001 annual outage. The number of incident reports is higher than in 2000 but is still below the average. The trend of incidents and shutdowns is positive and is becoming lower. More information on abnormal events is given in section 2.1.1.3.

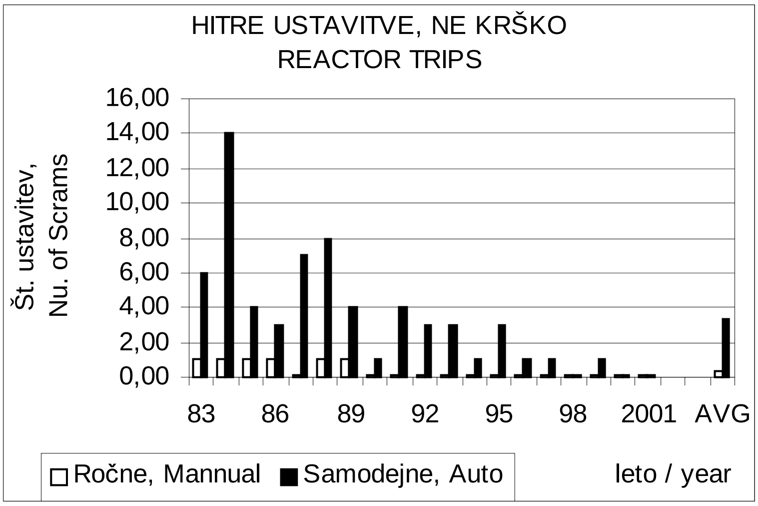

Figure 2.3: Reactor trips.

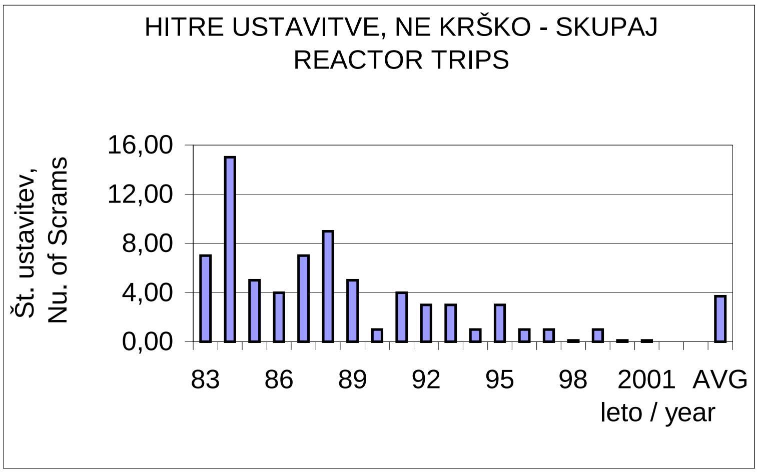

Figure 2.4: Reactor trips – total.

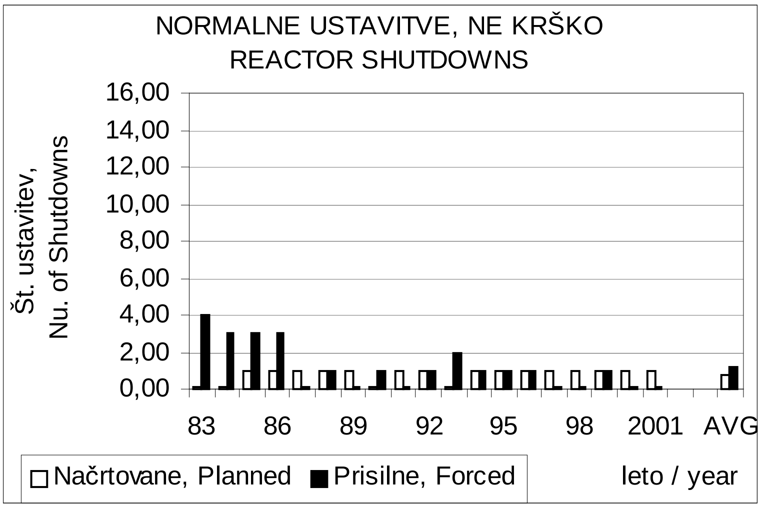

Figure 2.5: Reactor shutdowns.

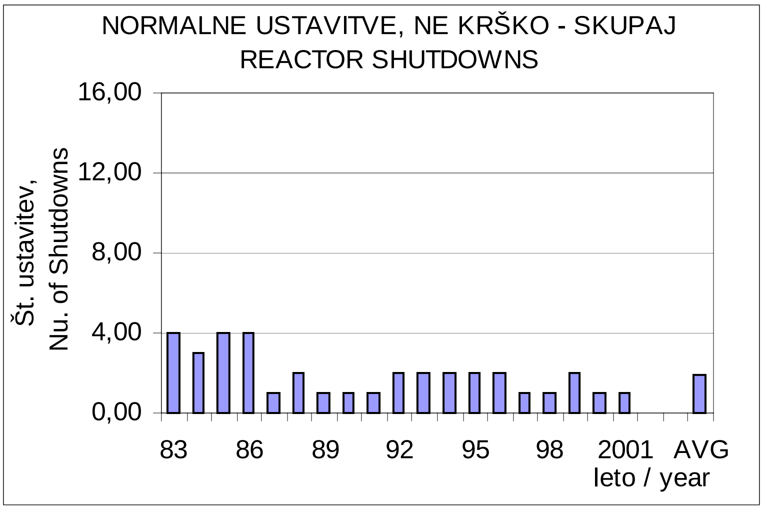

Figure 2.6: Reactor shutdowns – total.

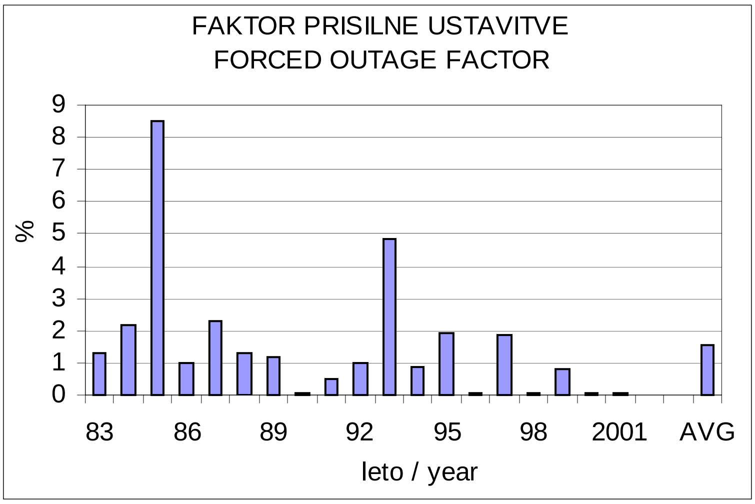

Figure 2.7: Forced outage factor.

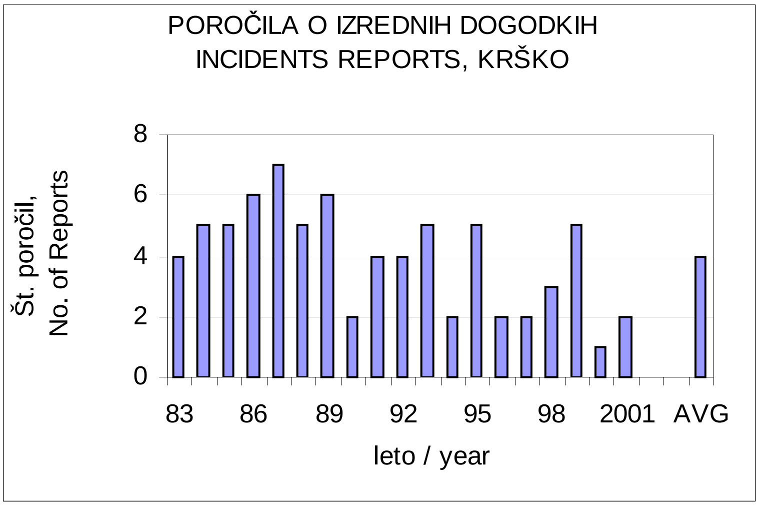

Figure 2.8: Incident reports.

The availability of the nuclear power plant is the ratio between the number of hours of generator operation (synchronised with the grid regardless of the power of the reactor) and the total number of hours in a given period. This shows the percentage of time of the NPP being connected to the grid.

The load factor is the ratio between the electrical energy produced and the electrical energy which could have theoretically been produced at maximum capacity in the same time period. In the calculations of the availability factor, the load factor and the forced outage factor, the total production of electrical energy since 1st January 1983, when the start-up tests were finished, was taken into account. In the tables below, the availability and reliability factors of the Krško NPP operating in 2001 are given. The indicators show that the operation of the Krško NPP was safe and reliable. The main performance data for the whole period of the NPP's regular operation is presented in order to compare data for the year 2001 to the previous period.

The load factor (Figure 2.9) is used world-wide as the main indicator of operational reliability of the power plant. In 2001 it was one of the highest ever in the entire operation period of the Krško NPP.

The availability factor (Figure 2.10) is another important factor in the presentation of the NPP's performance. In 2001, also the NPP's availability was very high.

In Figure 2.11, total electrical energy production for all years of the nuclear power plant operation is presented; in 2001, there was a record production of 5,036 GWh. This is the highest production of electrical energy so far, and the main contributors to this are high availability and load factor and especially the power upgrade of NPP Krško carried out two years ago.

Figure 2.12 offers a comparison between nuclear, hydro and thermal electrical energy production in Slovenia over several years. After the Krško NPP power upgrade of the reactor by 6.3%, the share of nuclear energy increased in comparison with the whole energy production in Slovenia and was about 39 %. The production of electrical energy increased in Slovenia by a gradient of about 2 %.

Figure 2.13 presents the outage duration, which has been getting shorter in recent years. This year it was by one third shorter than the year before, but still not the shortest one. Activities such as maintenance, modifications and in-service inspections have big influence on the duration of the outage. Table 2.4 presents details about outages from 1995 onwards, according to SNSA's data.

Table 2.4: The Krško NPP outage duration from 1995 to 2001.

	1995	1996	1997	1998	1999	2000	2001
Number of fuel cycle	11	12	13	14	15	16	17
Outage start	22 April	18 May	10 May	24 April	29 March	15 April	9 May
Outage duration	41.2	64.6	31.6	35.3	50.5	62.0	40.4
Power before shutdown [%]	100	99	100	83	100	91	73
Max. burn up [MWd/MTU]	48094	48333	44215	45677	49271	50437	49175
Next fuel cycle	12	13	14	15	16	17	18
Start of next fuel cycle	6 June	22 July	6 June	29 May	18 May	15 June	19 June
No. of new fuel elements in core	36	28	28	32	32	32	36

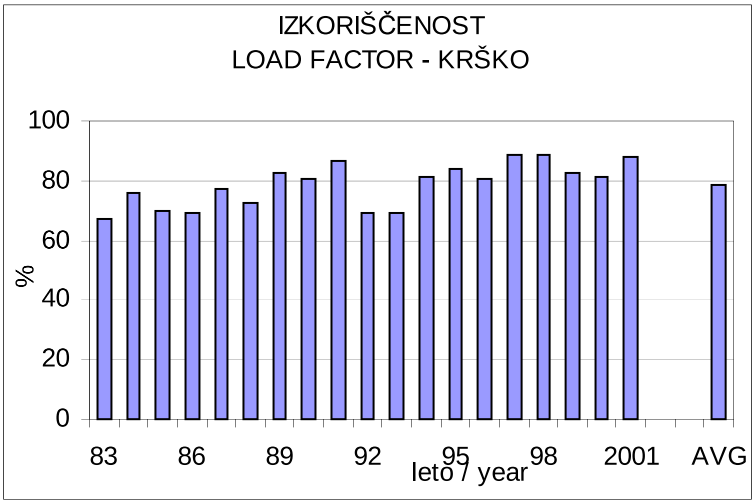

Figure 2.9: Load factor.

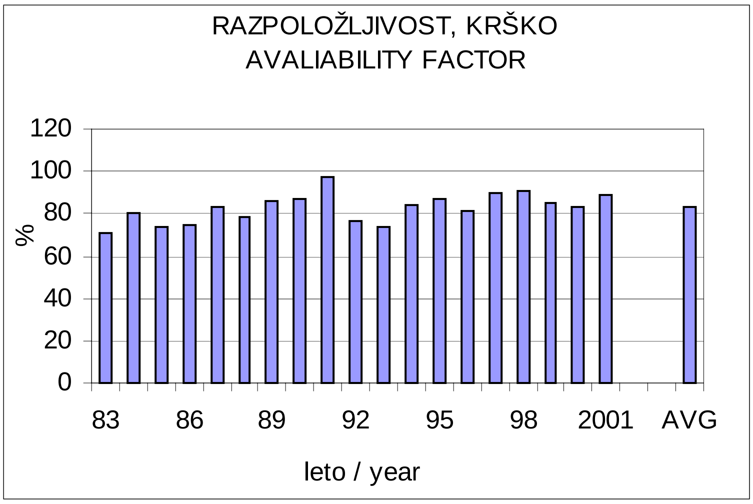

Figure 2.10: Availability factor.

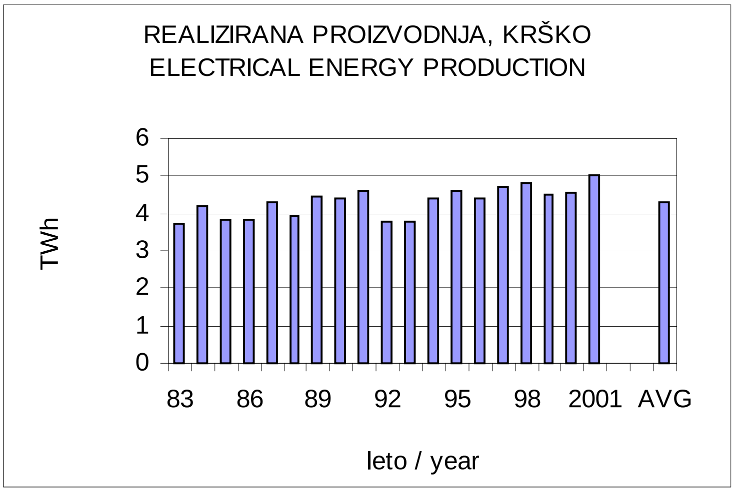

Figure 2.11: Actual electrical energy production.

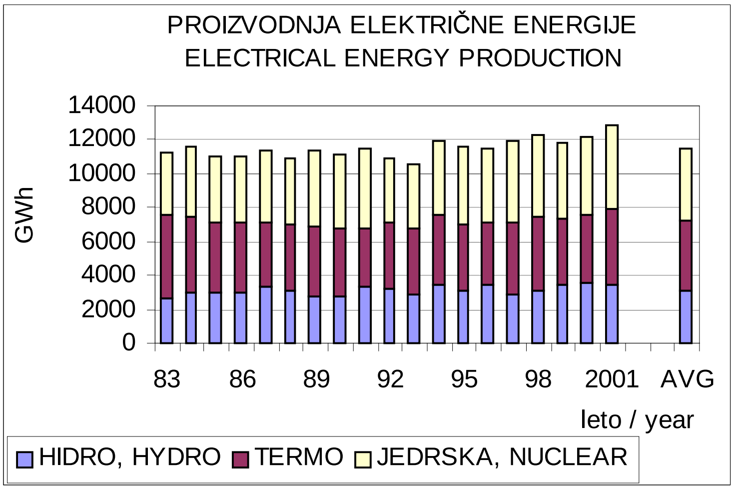

Figure 2.12: Electrical energy production.

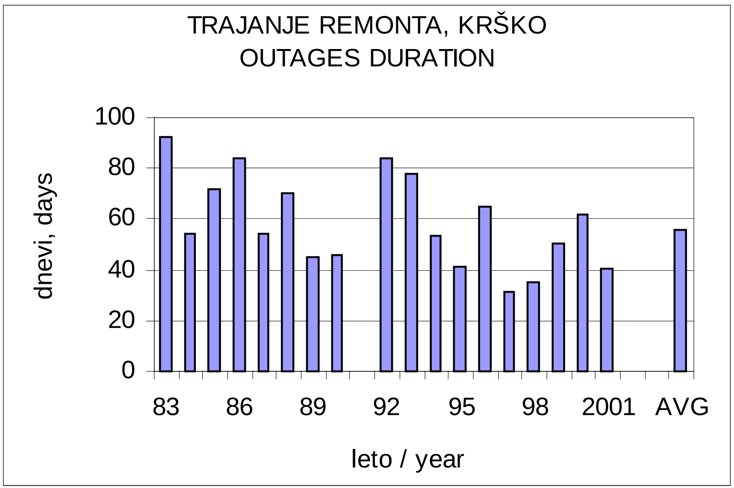

Figure 2.13: Annual outages duration.

The thermal performance indicator in Figure 2.14 shows the percentage of produced thermal energy as compared to the plan. In the last three years, the thermal performance was the highest although in 2001 and 2000 it was lower than in 1999 when the highest thermal performance was achieved. The explanation for the lowering of thermal performance on secondary side is that the optimum parameters changed due to the limitations with regard to the heating of the Sava river.

Figure 2.15 demonstrates the unplanned capability loss factor. This factor is calculated as a ratio of all unplanned energy losses to the reference energy generation (maximum production of energy). In the year 2001, just as the year before, there were no unplanned losses of power that would result from NPP activities.

Figure 2.16 indicates the number of unplanned automatic scrams per 7000 hours of critical operation. It is both a performance and a safety indicator which can be used when comparing the number of scrams in other NPPs. In the year 2001, just as during several previous years, this performance indicator shows a positive orientation.

Figure 2.17 (Unit capability factor) is defined as a ratio of available electrical production over a given time to the reference energy generation over the same time period expressed as a percentage. The indicator shows the capability of safe production of energy and reflects the plant's maintenance and managing. After the years 1997 and 1998 the value increased in the year 2001 up to 88.45 %, which is lower than the Krško NPP target value of 89 %, but has already exceeded the INPO goal for 2001.

The collective radiation exposure indicator in Figure 2.18 is two times lower than in 2000 and shows progress due to the minimising of NPP personnel exposure. The negative trend of the last three years has stopped but the values are still above the average of about 400 NPPs reporting to WANO. The Krško NPP's collective radiation exposure is also above the INPO target value. The main activities that contributed to this value were in-service inspection and modifications on the systems connected with the primary system. This safety indicator is the worst of all indicators and it is necessary to introduce measures for lowering radiation exposure.

The industrial safety rate (Figure 2.19) represents the ratio between the number of lost working hours resulting from occupational injuries and the total of working hours. In 2001, this ratio was 0.98 in 200,000 working hours and it has been moderately improving in the recent years. The NEK target value is 0.4 .

Figure 2.20 shows the high pressure safety system performance factor, which was a little higher since 1998 because of the maintenance works done during the plant operation. The maintenance of the plant on power shortens annual outages to a minimum. In 2001, the value of this indicator was 0.00127, and was 2.5 times lower than the year before, and it was even lower than the INPO value 0.02 and the Krško NPP value, which is 0.005. The value of the indicator did not increase in 2001; on the contrary, the Krško NPP actually succeeded in lowering it.

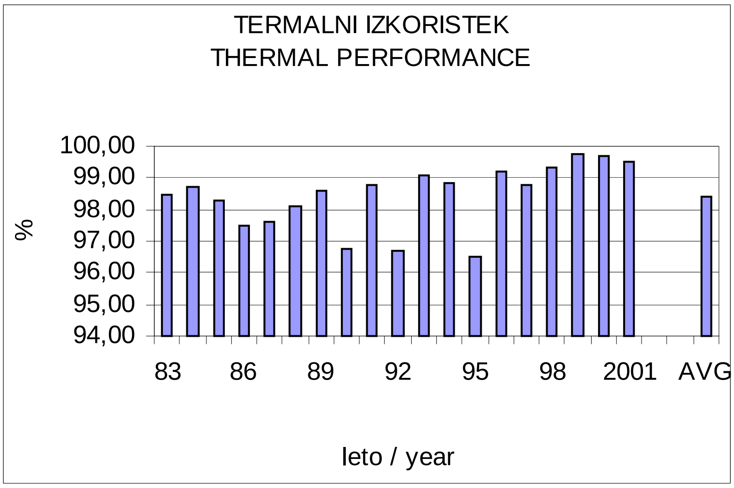

Figure 2.14: Thermal performance .

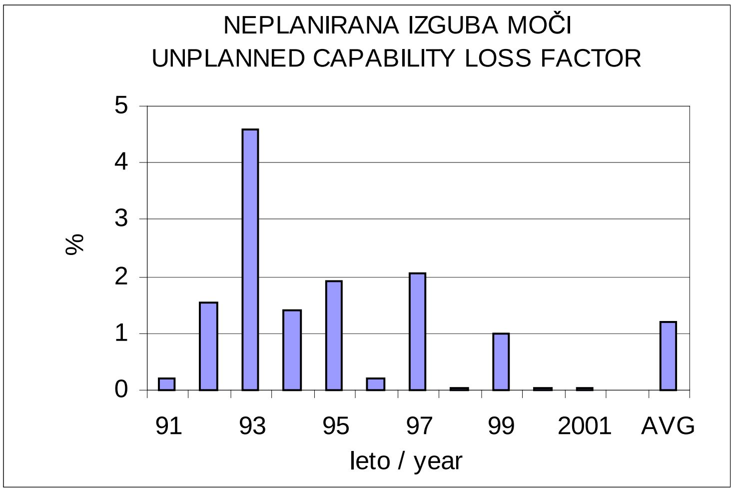

Figure 2.15: Unplanned capability loss factor.

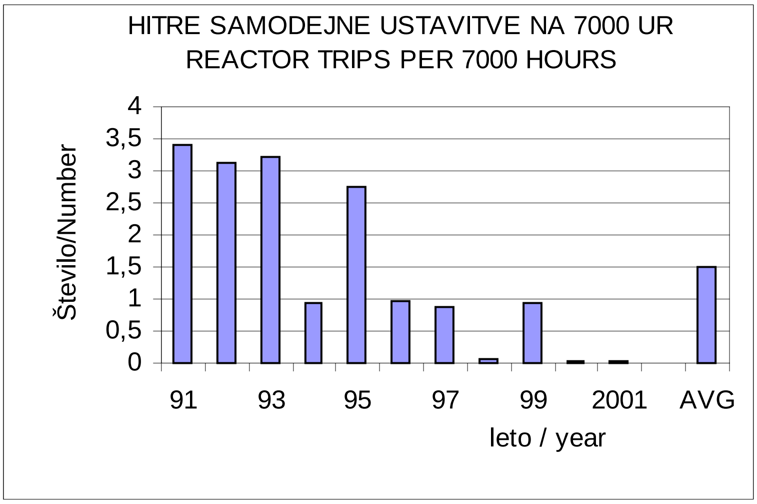

Figure 2.16: Unplanned auto scrams per 7000 hours critical .

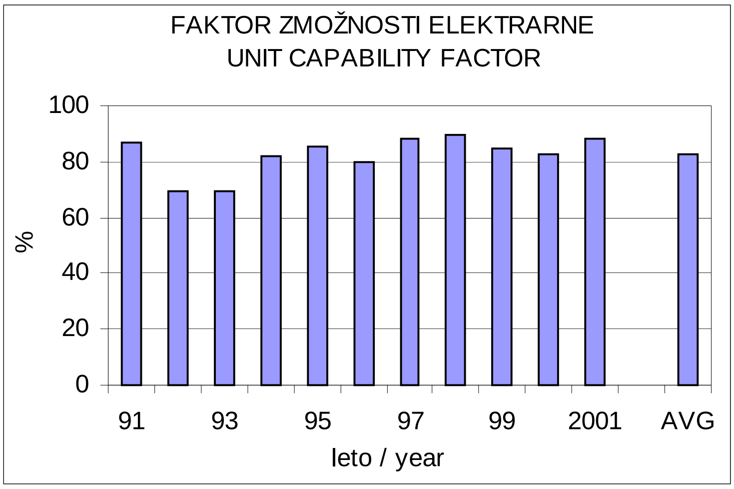

Figure 2.17: Unit capability factor.

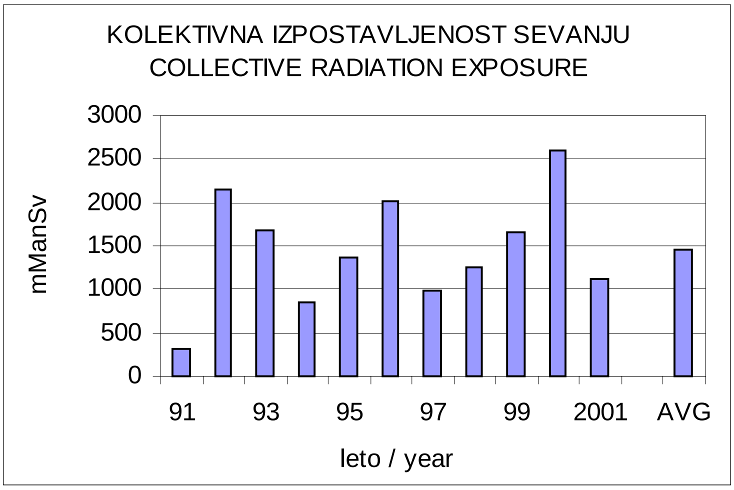

Figure 2.18: Collective radioactive exposure.

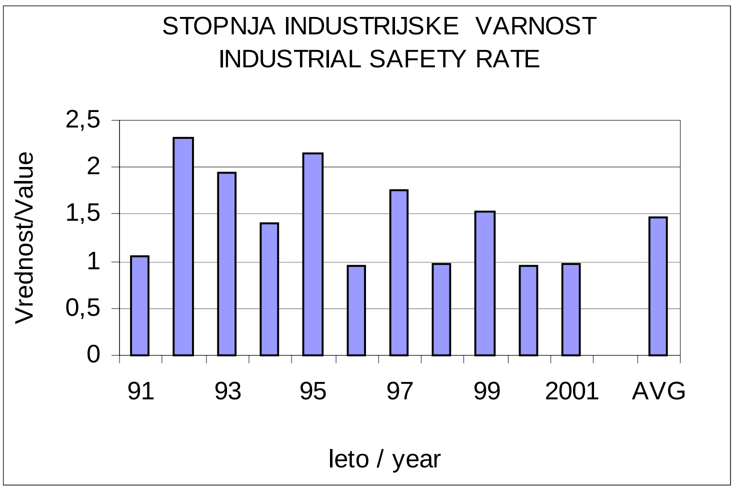

Figure 2.19: Industrial safety rate.

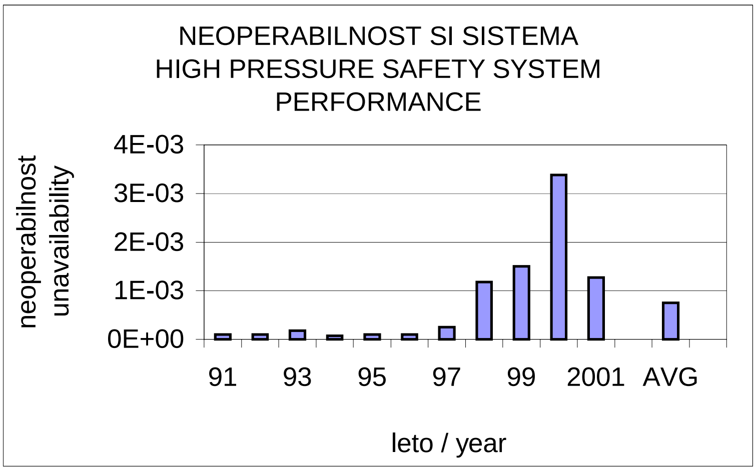

Figure 2.20: High pressure safety injection unavailability factor.

Figure 2.21 presents the number of unplanned actuations of the safety injection (SI) system. There was no actuation of the system at all in 2001. SI had not been actuated for four years in sequence, which is good for the NPP because every actuation lowers the lifetime of the facility.

Figure 2.22 presents the emergency power system (DG - Diesel Generators) unavailability factor, i.e. the electrical power system performance in case of on-site or off-site loss of AC power. Operability of the DG was stable in 2001 and was at a very high level.

Figure 2.23 presents the auxiliary feedwater system (AFW) unavailability factor, i.e. the performance of the auxiliary system for supplying feedwater into the steam generators when the main feedwater system is unavailable. Due to the maintenance during the plant operation this indicator is higher than in recent years. The AFW factor was 0.0008 in the year 2001, which is below the INPO value 0.020 and closer to the Krško NPP's target value (0.005).

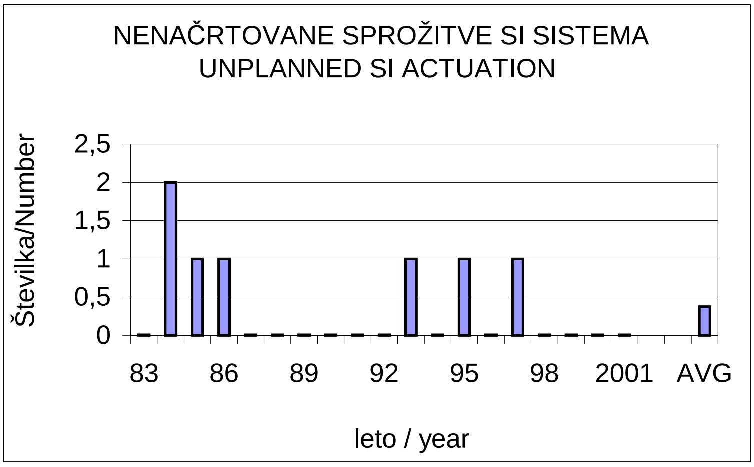

Figure 2.21: Unplanned safety injection system actuations.

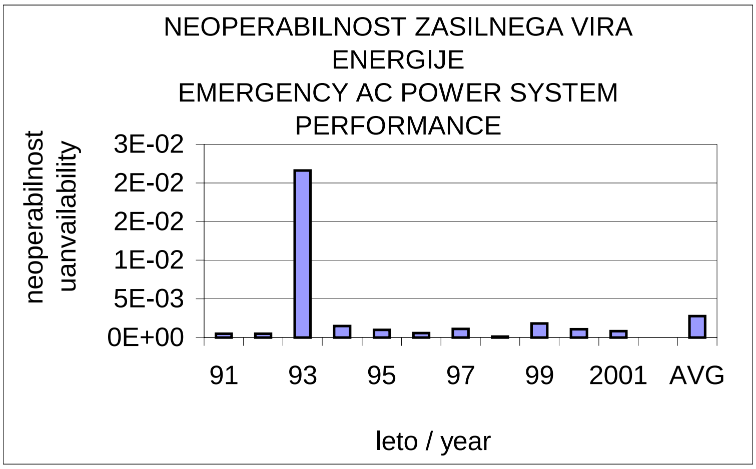

Figure 2.22: Emergency AC power system unavailability factor.

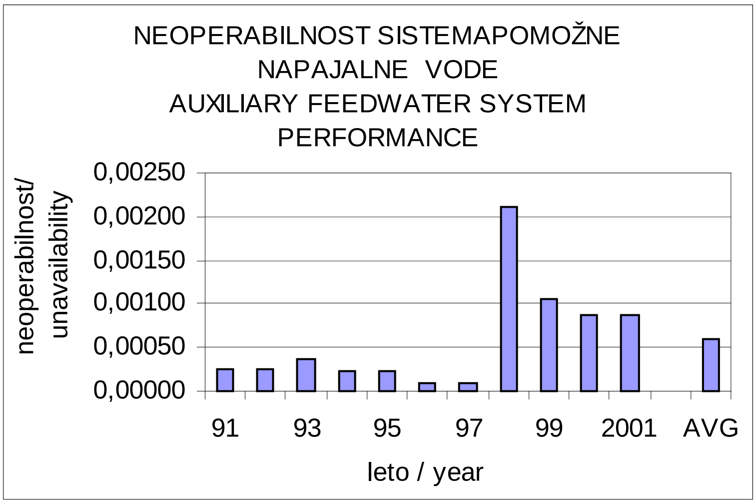

Figure 2.23: Auxiliary feedwater system unavailability factor.

Figure 2.24 indicates the chemistry indicator, which shows the quality of chemistry control of secondary water. The indicator is a combination of chloride, sodium, and sulphate concentrations in the steam generator blowdown system, iron and copper in the main feedwater system and oxygen in water with regard to their allowable concentrations. The indicator value is equal to 1 when concentrations are lower than permitted. The values of the chemistry indicator have been followed in the Krško NPP since 1996 and are very close to the INPO value of 1.1. The chemistry indicator in 2001 was 1.03 and is the best value in the last several years.

Figure 2.25 presents the effectiveness of surveillance failures from 1996 to 2001 and indicates the ability of failure discovering by testing. This ability is calculated as the ratio between the failures of equipment at surveillance testing and the total number of nuclear safety equipment failures. In 2001, the indicator value 92.31% was the highest in the last several years; the trend is stable, with a slight increase. This shows that the discovering and reporting of events, supported by better procedures and methods of testing and inspection, is more successful every year. The most important devices are fully under control.

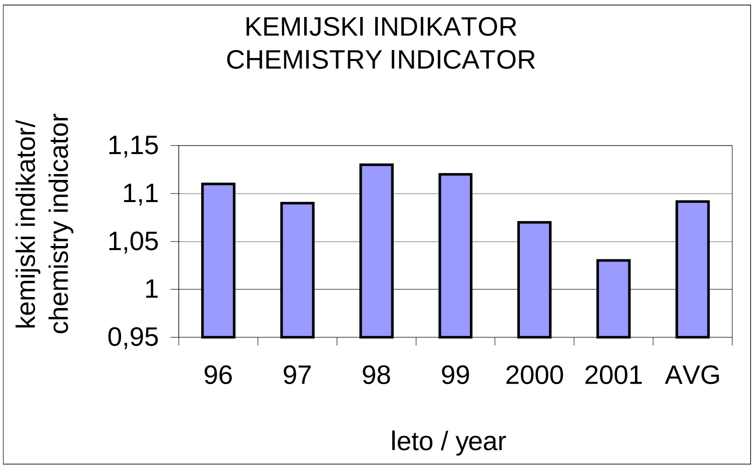

Figure 2.24: Chemistry indicator.

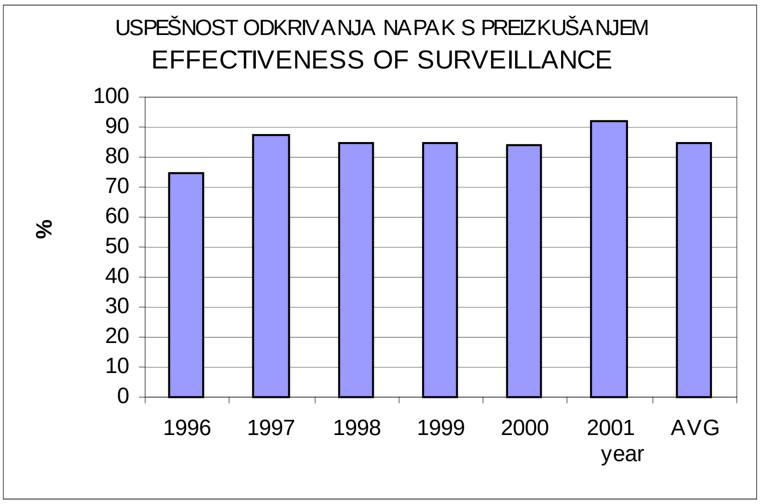

Figure 2.25: Effectiveness of surveillance.

Figures 2.26, 2.27, 2.28, 2.29, 2.30 present the nature of events from 1997 to 2001 and concern human failures, electrical failures, instrumentation failures, mechanical and other failures. The percentage of human failures is increasing every year, partly because in the revision of the procedure "Report on deviations" (which includes potential problems) the limits for reporting are lowered and partly because of reducing equipment failures due to better diagnostic methods of discovering malfunctioning of equipment. The share of human failures is high and it is in a relative increase.

Figure 2.31 presents the trend of occurrence of different types of events from 1996 to 2001.

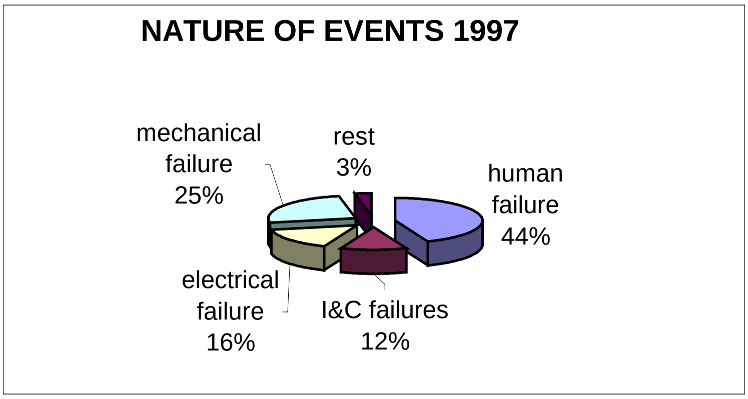

Figure 2.26: Nature of events in 1997.

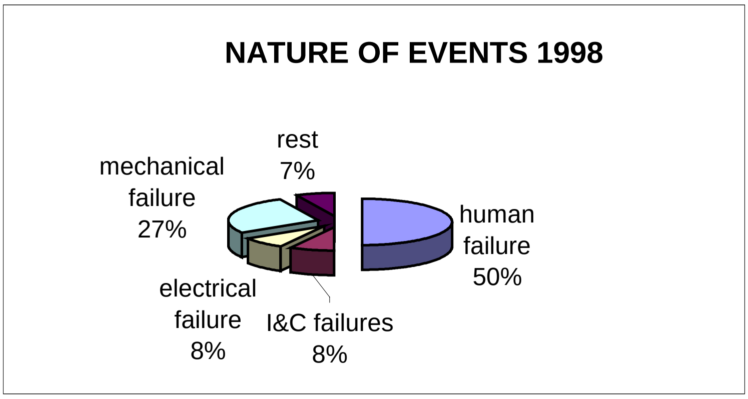

Figure 2.27: Nature of events in 1998.

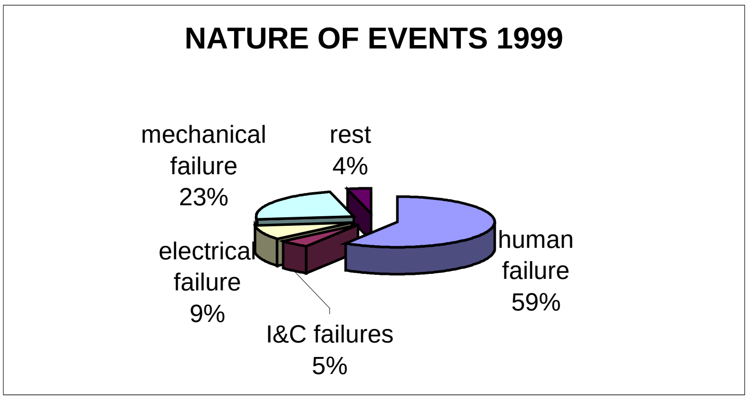

Figure 2.28: Nature of events in 1999.

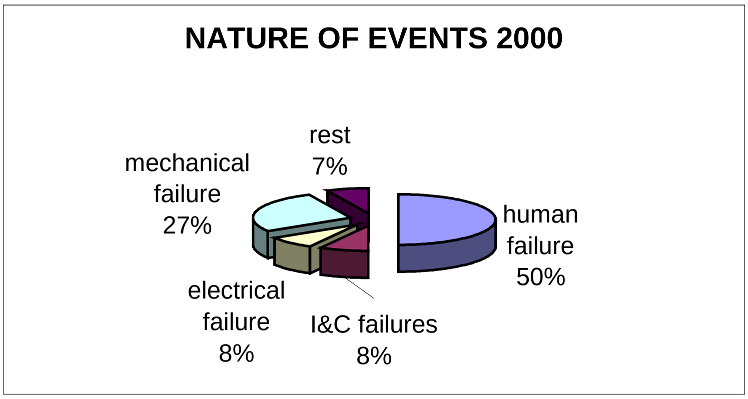

Figure 2.29: Nature of events in 2000.

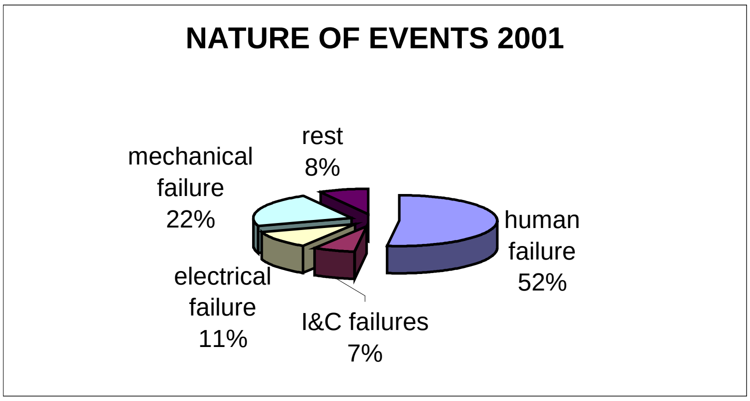

Figure 2.30: Nature of events in 2001.

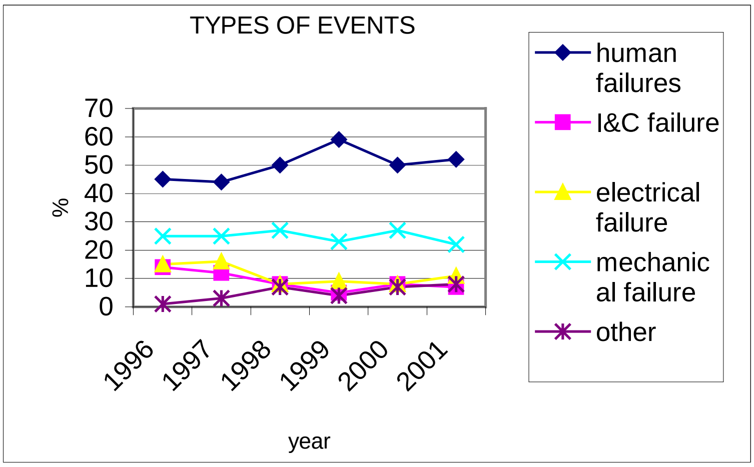

Figure 2.31: Types of events.

Fire protection safety is an important element of nuclear safety and is carefully observed. There are 373 fire detectors in the Krško NPP, which in the year 2001 detected 21 events in the technological part, and 53 events in the non-technological part. A real fire did not occur in either the technological or the non-technological part of the facility. Table 2.5 presents all events and real fire accidents in the technological part of the plant from 1983 to 2001. In 2001 the number of alarms was higher than in previous years. Mostly the alarms were initiated (90 % - 95 %) by heater sources in the course of welding or grinding in the NPP. Also the dust of construction works and cigarette smoke (in the non-technological part) caused some alarms. In 5% - 10% of all cases there was no explanation for the set-off of the alarm. Since there is no accurate data on the reliability of alarm detectors, the number of alarms is not a reliable indicator of fire protection safety. For the period 1983-1997 there is no data about the number of alarms.

Table 2.5: Number of fire alarms and real fires 1983-2001.

Year	No. of alarms	No. of fires
1983	*	0
1984	*	0
1985	*	0
1986	*	1
1987	*	0
1988	*	0
1989	*	0
1990	*	0
1991	*	1
1992	*	2
1993	*	0
1994	*	0
1995	*	0
1996	*	1
1997	*	0
1998	43	0
1999	20	1
2000	13	2
2001	74	0

Operational safety also depends on the number of violations of operational conditions specified in the Technical specifications of the Krško NPP (NEK-STS). In the period from 1996 to 2000 there were no such violations.

On 25 December 2001 the level of the Sava river was very low and despite reducing the power, the Krško NPP exceeded the daily permitted temperature difference by 0.07°C at the spot of total mixing of cooling water with water of the Sava river.

The data about operating in Limited Conditions for Operation (LCO; operating time limitation of equipment at the lowest functionality conditions still ensuring safe operation of the NPP) are given in Table 2.6. The figures refer to the number of cases for each year.

Table 2.6: Plant Operation in Limiting Conditions for Operation (LCO) 1999-2001.

	1999	2000	2001
Breaker change due to corrective maintenance	0	10	29
Breaker change due to failure of component or equipment	0	0	3
Breaker change due to surveillance	57	26	22
Corrective maintenance	55	55	32
Equipment failure	54	74	41
Modifications	0	7	3
Preventive maintenance	75	69	64
Surveillance	111	102	114
Total	352	353	308

The number of cases when NPP operated with unavailable equipment but still inside the LCO were in the last three years much higher than before, which is mainly due to preventive maintenance on power; the indicator is generally stable or even in a slow decrease.

Table 2.7 shows the results of reliability tests for both diesel generators from 1985 to 2001. The results show that the start-up and the operation reliability are higher than the required reliability in the Technical specifications. There were 189 working orders issued for corrective maintenance of safety systems on power in 2001. 2 working orders were not carried out or concluded in three months in 2001, which is much less than the year before.

Table 2.7: Results of reliability tests for both diesel generators from 1985 to 2001.

	Number of tests				Reliability [%]		
	Start-up		Operating				
	Tests	Failures	Tests	Failures	Start-up	Operation	Total
DG1	290	3	287	5	0.99	0.98	0.97
DG2	288	3	285	3	0.99	0.99	0.98

2.1.1.2 Shutdowns and Reductions of Power

The data on shutdowns of the Krško NPP for 2001 are presented in Table 2.8 and the reductions of power in Table 2.9. In the Krško NPP lifetime there have been in total 173 shutdowns, 66 of them occurring in 1981 and 1982, before the beginning of commercial operation. Most of the latter were automatic shutdowns caused by failures on equipment, testing of equipment and initial operating problems that can be expected at the beginning of operation of a new facility. During the commercial operating period of the facility, from 1983 onwards, there were in total 107 shutdowns. There were 70 reactor trips, i.e. shutdowns as a consequence of activation of the reactor safety system, which can be activated manually or automatically (64 shutdowns were automatic and 6 were manual). Normal shutdowns (continuously decreasing of power – step by step) were 37; 22 of these were unplanned (forced) and 15 planned (13 of these due to annual outage, 1 because of the aggression on Slovenia in 1991 and 1 because of seismic threat). The number of shutdowns due to refuelling and annual maintenance is lower than the number of operating years of the NPP, because in 1991 there was no annual outage due to a longer fuel cycle. Figures 2.3 to 2.6 graphically present the shutdowns. In 2001 the Krško NPP operated 40 days with reduction of power due to a small flow of the Sava river (following the administrative limitation of heating of external medium in the spot of mixing) and 38 days due to prolongation of the fuel cycle. Short power reductions (a few hours) occurred eight times due to turbine valves testing and once due to the turbine control valve’s (No.2) control loop repair.

Table 2.8: The Krško NPP planned and unplanned shutdowns in 2001.

Date	Duration [h]	Type	Mode	Cause
9 May	969.2	planned	manual	2001 outage (5 May – 18 June)

Table 2.9: The Krško NPP planned and unplanned reductions of reactor power in 2001.

Date	Duration [h]	Cause
7 January	3.5	Operating at reduced power (92%) due to turbine valves testing
14 January	4	Operating at reduced power (92%) due to No.2 turbine control valve's control loop repair
4 February	3.5	Operating at reduced power (92%) due to turbine valves testing
4 March	3.5	Operating at reduced power (92%) due to turbine valves testing
1 April	912.8	Gradually decreasing of power due to prolongation of fuel cycle
22 July	3.5	Operating at reduced power (92%) due to turbine valves testing
10 August	34	Operating at reduced power (max 93%) due to limitation of heating of the Sava river (as source of cooling)
16 August	479	Operating at reduced power (max 85%) due to limitation of heating of the Sava river (as source of cooling)
16 September	3.5	Operating at reduced power (90%) due to turbine valves testing
14 October	3.5	Operating at reduced power (90%) due to turbine valves testing
18 October	6	Operating at reduced power (82%) due to condenser cooling pumps testing
11 November	4	Operating at reduced power (90%) due to turbine valves testing
9 December	4	Operating at reduced power (92%) due to turbine valves testing
11 December	453	Operating at reduced power (max 90%) due to limitation of heating of the Sava river (as source of cooling)

2.1.1.3 Reports of abnormal events in the Krško NPP

In 2001, the Krško NPP reported to SNSA about two abnormal events. High daily temperatures in summer days caused higher temperatures also in the buildings where sources of additional heat are present. One such building is the intermediate building with the main steam line, the main steam isolation valves and the safety valve of the main steam line. The highest temperatures measured in some parts of the building were 48.1°C and exceeded the permitted value by 2.1°C. This happened on 4 August 2001. The duration of this event was 8 hours and 17 minutes and because of that, between 22:06 and 22:23, the Krško NPP was operating in limited conditions according to NEK-STS – »LCO 3.7.13 – Area Temperature Monitoring«. During the LCO there was no impact on the safety components in this area, because they are designed for higher temperatures. (e.g. cables of the safety equipment have a range of normal operating up to 90°C, and the other equipment has even a higher upper limit). Temporarily, the Krško NPP solved the problem by opening the door that leads to the turbine building and in this way improved ventilation. As a long-term measure, the Krško NPP will evaluate the operation of the ventilation units and their suitability, and investigate the possibility of additional thermal isolation of this part of the building and equipment, especially piping.

The second event happened on 27 December 2001, when at the planned testing of the solid state protection system (SSPS) of the reactor on train A, during the execution of the required steps by procedure SMI-4.049, an error was detected (indication »BAD« appeared). During the testing the NPP operated at 99.6% of power. Analysis of the failure showed that the test was unsuccessful due to a failure of electronic parts on the universal card that activates the containment spray and isolates containment for the phase B. The other SSPS on the safety train B was operable and in the case of emergency all the equipment on train B would perform its function. Although the system did not operate due to the card failure, manual activation of the reactor containment spray and isolation of containment for the phase B from both trains A and B was possible. After an urgent replacement of the card the test was successfully repeated and concluded. Considering the fact that during the operation it is not possible to find out whether some train is operable or not it is necessary to perform the SSPS test of operability every 30 days. This was the first time that such failure was discovered in the Krško NPP and as a consequence, besides the regular testing and maintenance of the SSPS, the SSPS will be completely replaced with a new one during the 2007 outage.

2.1.1.4 Fuel integrity and activity of the reactor

The year 2001 comprises parts of the 17th and 18th fuel cycle. The 17th fuel cycle ended on 9 May 2001. After the planned shutdown (refuelling and maintenance), the reactor reached criticality on 17 June 2001, when the 18th fuel cycle started.

In the core of the 17th fuel cycle, 107 fuel elements had a modified bottom end nozzle (DFBN, Debris Filter Bottom Nozzle)). Cladding, guide tubes of control rods and instrumentation of 88 fuel elements were made from ZIRLO material. 60 fuel elements had circular enriched annular pellets in the axial blanket. 32 new fuel elements in the 17th cycle had a Removable Top Nozzle.

In the core of the 18th fuel cycle, 108 fuel elements had a DFBN. Cladding, guide tubes of control rods and instrumentation of 100 fuel elements were made from ZIRLO material. 92 fuel elements had circular enriched (2.6%) annular pellets in the axial blanket. 68 new fuel elements in 18th cycle had a Removable Top Nozzle, of these 36 were new fuel elements.

Fuel integrity is monitored indirectly by measuring the specific activity of the reactor coolant. Isotopes of iodine and noble gases are especially suitable for this purpose. Data on the activity of the primary coolant are presented in Table 2.10, while Figure 2.32 presents the contamination of the primary coolant with uranium.

The analysis of the reactor coolant specific activity until the end of March 2001 showed that no fuel elements in the core had been damaged during the 17th cycle. According to the performed analysis, the specific activity remained within the limits prescribed by the Technical specification TS-3.4.8. Fuel state fundamental indicators for the core of the 18th cycle that showed no fuel elements were degraded until the end of December 2001.

The fuel reliability indicator (FRI) represents the I-131 specific activity corrected for I-134 contribution from dispersed uranium in the primary coolant circuit, normalised to the constant cleaning rate value. The FRI values, calculated by the improved method for cycles 17 and 18 are presented together with values for cycles 14, 15 and 16 in Table 2.11 and Figure 2.33.

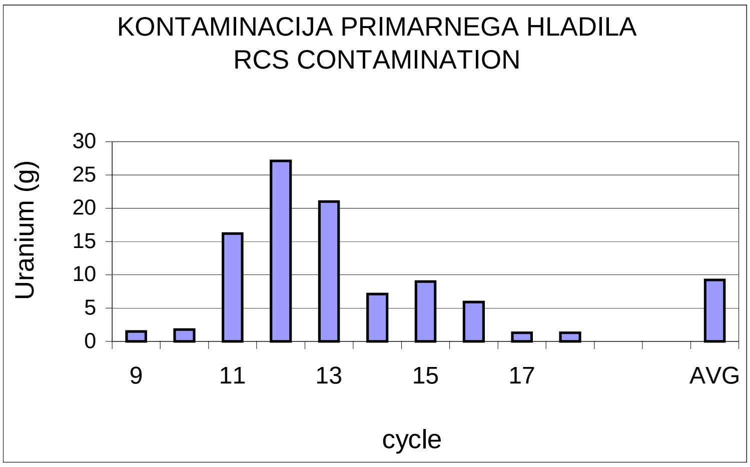

Figure 2.32: RCS contamination.

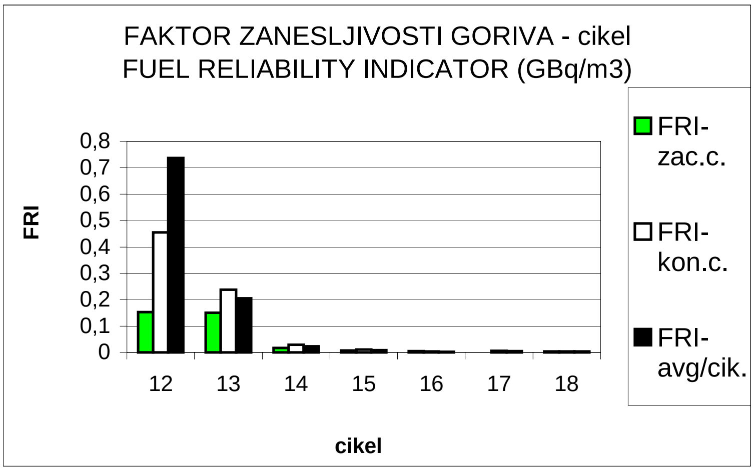

Figure 2.33: Fuel reliability indicator.

Control of cladding tightness was performed during Outage 2001 by the "In Mast Sipping" (IMS) method. This test confirmed that no fuel elements of the 17th cycle had been degraded. After unload of the 17th cycle core, inspections of spring screws of upper nozzles on 72 fuel elements were performed. No elements had damaged springs. Analysis by Westinghouse, based on the examination of video recordings and the inspection report, permits further use of all 72 inspected fuel elements.

The final design of the core was composed of elements with proved integrity, using methods of tightness testing and testing of upper fuel element nozzles springs. The core design of the 18th cycle permits 12 months of operation at updated power.

Table 2.10: The average values of primary water activity.

Isotope	Average activity [10^9 Bq/m^3]											
	Cycle 13		Cycle 14		Cycle 15		Cycle 16		Cycle 17		Cycle 18 (17.6.-31.12.2001)	
	a)	b)	a)	b)	a)	b)	a)	b)	a)	b)	a)	b)
I-131	0.18	0.09	0.01	0.04	0.04	0.01	0.04	0.04	0.02	0.02	0.01	0.01
I-133	2.22	1.24	0.12	0.57	0.54	0.12	0.57	0.54	0.25	0.23	0.13	0.12
I-134	9.29	4.50	0.49	2.75	2.59	0.49	2.75	2.59	1.03	0.95	0.60	0.54
Xe-133	5.04	2.36	0.28	1.14	1.06	0.28	1.14	1.06	0.58	0.50	0.32	0.29
Xe-135	5.4	3.23	0.32	1.41	1.36	0.32	1.41	1.36	0.65	0.60	0.39	0.36
Xe-138	7.31	3.81	0.35	2.01	1.97	0.35	2.01	1.97	0.73	0.72	0.47	0.44
Kr-85m	0.71	0.38	0.04	0.17	0.17	0.04	0.17	0.17	0.08	0.06	0.04	0.04
Kr-87	1.28	0.71	0.07	0.33	0.33	0.07	0.33	0.33	0.15	0.15	0.09	0.08
Kr-88	1.75	0.97	0.08	0.45	0.44	0.08	0.45	0.44	0.17	0.16	0.10	0.09
EFPD [day]	274.2		309.6		298.4		316.7		308.9		190.9	
Max. Burn up of element [MWD/MTU]	44215		45677		49271		50437		49175		46998	

a) stable condition, b) all measurements

Table 2.11: FRI values for cycles 14, 15, 16, 17 and 18.

	FRI [Ci/m^3]				
	Cycle 14	Cycle 15	Cycle 16	Cycle 17	Cycle 18
Start	1.73E-03	7.75E-04	4.78E-04	8.66E-06	3.27E-05
End	2.90E-03	1.08E-03	1.43E-04	6.62E-05	/
Average (all measurements)	2.33E-03	8.69E-04	3.01E-04	4.57E-05	3.89E-05 (in 2001)

Sources: Krško NPP Annual Report 2001, Feb. 2002

Performance indicators for the year 2001, Krško NPP, Feb. 2002

Data on realised electric energy production in 2001, ELES, Operational department

Review of operational and safety indicators, letter from NPP Krško No. ING.NOV-040/2002/6399, from 14 May 2002.

2.1.2 SAFETY ASSESSMENTS AND LICENSING

2.1.2.1 Technical Improvements and Modifications to the Krško NPP

Modification of a project or project bases of nuclear facilities or modification of nuclear facilities operating conditions are among the main activities that could have an impact on the safety and control of nuclear facilities.

The SNSA gives special attention to nuclear safety, especially to a high safety level of the Krško NPP. This concern includes improvements in the power plant itself based on the best international practices and the latest developments and experiences in the nuclear field.
NPP Krško follows its own evaluation procedures of modifications and files applications to the SNSA for any modifications and changes of the USAR which - through safety evaluation and safety evaluation screening – reveal an unreviewed safety question, as well as for all changes in the Technical Specifications.

After reviewing the application, the Technical documentation and an Independent technical opinion, the SNSA issues a license with a decision for the implementation of the modification or change of the Technical documentation. Other modifications, which do not reveal an unreviewed safety question, are approved by the SNSA with a short statement.

2.1.2.2 The modifications in 2001, for which a decision was issued by the SNSA

1. Modification 152-RC-L: »Low temperature Overpressure Protection – LTOP« The aim of the modification was to assure protection of RCS against sudden rises of pressure when operating at low temperatures. Protection is requested in NUREG 0800, Chapter 5.5.2. For the overpressure protection the existing relief valves on the RHR lines were replaced with valves having greater relief capacity. Consequentially also the relief pipes and support were modified. The electrical interlock for the closure of RHR to RCS isolation valves was removed.

2. Modification 350-RC-L: »Loose parts monitoring«. The temporary analogy system for identifying loose parts in primary circuit was replaced with a new digital multichannel system. Ten new detectors were added on the primary and secondary side (Steam Generator). An Acquisition Cabinet with a digital system was installed in the computer room. The alarm which will activate abnormal state of noise in RCS leads to an alarm window in MCR.

3. Modification 356-FP-L: »Installation of Fire protection alarms in the »In Drum Drying System« (IDDS)«. After the event of spontaneous ignition of the rags which were being dried in IDDS, the SNSA licensed an application to continuously observe IDDS from the viewpoint of fire protection. The event had no consequences on operation of the facility, neither did it cause any material damage. Two smoke detectors and a manual actuation switch were installed in the IDDS. The detectors cover the whole space of the IDDS and are connected to the main FP cabinet.

4. The SNSA approved the NPP Krško »In-service Inspection Programme«, TD2E, for the next ten years, except the alternative methods for the inspection of the reactor coolant pump, according to ASME Code Case N-481. The whole USAR chapter 16.4.2 In-service Inspection should be removed. The Standard Technical Specification of the NPP Krško, chapter 3.0 »Applicability«, subchapter »Surveillance Requirements« SR 3.05, should be modified.

5. The SNSA issued a decree concerning »Radiological inspection at the NPP Krško in 2001«, by which it decides that in 2001 the NPP Krško has to ensure measurements according to the

program Radiological inspection of immissions, of gas and fluid emissions, measurement of radioactivity in the systems, inventory of NSRAO storage, and maintenance of preparedness.

6. The SNSA issued a decree on the subject of »Meteorological measures in the surrounding of the NPP Krško for the year 2001«. The NPP Krško should carry out measurements in its surroundings according to the added description of procedures, continuously maintain basic meteorological data and ensure a reliable computer transfer of data to SNSA.

7. The SNSA approved to the NPP Krško modification of STS (Standard Technical Specifications) in chapter 16.4 Surveillance Requirements for radiological monitoring in the Multi purpose building (MPB – storehouse for old steam generators and decontamination). There were minor changes concerning the minimum frequency for checking, calibration and testing.

8. The SNSA ordered the NPP Krško to make a programme of »Periodic Safety Review of the NPP Krško". The programme was to contain a brief description with the time schedule and had to be submitted to the SNSA by 30 March 2001. The programme was also required to be in accordance with the IAEA Safety Guide »Periodic Safety Review of Operational Nuclear Power Plants« No.-50-SG-012 and with European practice.

9. The SNSA approved the application of the NPP Krško to purchase nuclear material: 36 new fuel elements with 4.35% enrichment of Uranium and with total activity of 1551.78 GBq.

10. The SNSA approved the application of the NPP Krško to trade with nuclear materials in the case of imports, purchase and transfer of new fuel elements for the needs of the NPP Krško until 31 December 2001.

11. The SNSA confirmed that new fuel elements were packed according to the description of the packing and approved the radioactivity content, described in the »Competent Authority Certification for a Fissile Radioactive Materials Package Design Certificate USA/9239/AF, Revision 12«, which had been approved by the Ministry of Transport of the USA on 21 December 2000, with the enclosure »Certificate of Compliance for Radioactive Materials Packages USA/9239/AF, Revision 11«, approved on 31 December 2000 by the US NRC.

12. The SNSA approved to the NPP Krško a modification of STS in chapter 3.4.10 »Structural Integrity«. The limiting conditions for operation were added, which ensure mechanical integrity of the components by categories 1, 2, 3, according to the ASME Code Class.

13. The SNSA approved the proposed annual Plan for training and education of the NPP Krško personnel for 2001. The plan was in accordance with the Regulation on education, experience, examination and certification of personnel conducting specific work at a nuclear installation.

14. The SNSA gave the NPP Krško permission for transfer nuclear material across the border of and within the Republic of Slovenia, namely of 36 fuel elements (fission material OZN, No. UN 2918, class 7) with the highest enrichment of Uranium up to 4.35% and total activity 1551.78 GBq. The total mass of uranium was 14,638.924 kg, 612.942 kg of which was the U^{235} isotope. The fuel elements were packed two by two in 18 chests marked with USA/9239/AF type A (II-yellow), and were transported in 9 containers 20´(III-yellow) with containers two by two, model of packing MCC-3.

15. The SNSA approved to the NPP Krško modification of STS because of Surveillance requirements changes in section 3: SR 3.1.3.1.2, SR 3.3.2.1., SR 3.6.5.1., LCO 3.4.4., SR 3.5.1.1.b, LCO 3.5.1., SR 3.6.5.2, LCO 3.8.1., SR 3.10.1.2. The SNSA did not approve STS changes in sections 3: SR 3.5.2.c.2, SR 3.3.3.1, SR 3.6.2.1.d, SR 3.7.1.2. The changes are in accordance with NUREG 1366, the programme of improvements of Technical Specifications in the sense of lowering and minimising Surveillance requirements.

16. The SNSA approved to the NPP Krško changes of STS concerning »Pump Performance Curves«, SR 3.5.2, SR 3.6.2.1, SR 3.7.1.2, Bases 3.5.3 and B 3.7.1.2. These will remove discordances between the NPP Krško Surveillance requirements and the operating values defined in the Safety and System Analysis for Steam Generators replacement and the NPP Krško power uprate.

17. The SNSA approved to the NPP Krško changes of STS concerning »Electrical Power Systems – DC- Sources – Operating«, SR 3.8.2.1, which define requirements for operability of the 125 V DC system with new batteries.

18. The SNSA approved to the NPP Krško changes of STS concerning »Steam Generators«, SR 3.4.5., and the content of the procedure ADP-1.4.322, rev.0, »In-service Inspection of Steam Generator Tubes«, which covers the enlarged extent of examination of new Steam generator tubes.

19. The SNSA approved to the NPP Krško changes of STS concerning »Low temperature overpressure protection of the reactor coolant system – LTOP«, SR 3.4.9.3, and change of USAR in chapters 5.0, 5.2,5.5,5.6, and 7.6. This also covers LTOP protection with two relief valves on the suction side of the Residual Heat Removal (RHR) pumps.

20. Concerning the »Safety analysis for power uprate and replacement of SG of the NPP Krško", the SNSA approved analyses of SG replacement and power uprate, a temporary change of the content of STS until the end of the 19th burn up cycle, and temporary use of LBB methodology until the end of the 19th burn up cycle.

21. The SNSA approved to the NPP Krško a Revision of chapter 13.3 of USAR Planning of measures for the case of emergency and critical events. It should be supplemented with figures, tables, schemes, etc. to comply with the recommendations from NUREG 0654.

22. The SNSA approved to the NPP Krško changes of STS concerning »Cooldown and Heatup Curves for 16 EFPY« in chapter SR 3.4.9, which were valid until 31 December 2001. It also approved changes of STS concerning the »Reactor Coolant System«, SR 3.4. In accordance with the programme of reactor vessel inspection and on the basis of three surveillance sondes, new limitation curves have been approved, which will be valid until 32 EFPY.

23. The SNSA approved conditional operability of the essential service water pump SW101PMP03C under special conditions (river Sava temperatures) until the end of the annual outage 2002.

24. The SNSA approved the programme and realisation of the programme »Periodic Safety Review of the NPP Krško (PSR), No. ESD-TR03/01, rev.1, July 2001. The programme contains a systematic and fundamental review of operation of the NPP Krško, including changes as a result of modernisation of the facility.

25. On the basis of valid legislation, the SNSA rejected the request of the NPP Krško to exclude used motor oil contaminated with isotopes Cs-137 and Co-60 from permanent Radiological inspection.

26. The SNSA approved to the NPP Krško changes of STS in sections 1. »Definitions« and 3.10.3 »Physics Tests«. The changes of STS were made to remove the errors made at the time of writing the report SSR-NEK-10.4 and, consequently, the mistakes made while preparing the standard NEK-STS format on the basis of NUREG 04522, Rev.5.

27. The SNSA approved changes of STS concerning »Typing errors correction in LCO 3.1.3.1 and LCO 3.1.3.6«. The numbering of Figure 3.1-4 was wrong.

28. The SNSA approved to the NPP Krško changes of STS due to RTP 400/110kV Krško construction and adaptation of the entrance building. The works concerned shifting of the safety fence so that the RTP – Transformer station is located outside the safety zone of NPP Krško. The NPP Krško entrance building was enlarged.

29. The SNSA approved to the NPP Krško changes of STS concerning »Motor valve CC-10301 removal from the NPP Krško, TS LCO 3.6.4, Table 3.6-1«. That was clearly a mistake in the NPP Krško STS. In the component cooling system, isolation of the containment building is designed with two (Safety class 2) valves (No. 10302 and 10307), while 10301 (Safety class 3) does not satisfy the requirements for containment isolation valves.

2.1.2.3 Modifications approved by the SNSA

1. Modifications 352-XR-L and 349-XR-L
»Replacement and Installation of one Main transformer (GT1)«. One of the Main transformers was replaced with a new one. It was connected to the existing system of protection, signalisation and alarming. The configuration and all the equipment were subjected to minor changes. The mode of automatic parallel operating is the same as for other transformers – the regulation of voltage in the course of transmission of power to the grid is made with a single voltage regulator which dictates the level of the regulation switch on both transformers. Because of lower short circuit impedance – Uk (12.83% against 15.12%) the new transformer is relatively more loaded than the old one (60% - 40%). The potential problem of overheating of the transformer winding in the process of power transmission to the grid during the summer season has in this way been removed. The replaced transformer has been conserved and stored as a backup.

2. Modification 086-CC-L
Installation of a containment isolation valve in the CC (Component Cooling System) RCP pump cooling line. Additional isolation valves were installed in the CC line to the Reactor Coolant pumps and to the heat exchanger of the primary circuit drain tank (RC- Reactor Coolant System Drain Tank Heat Exchanger). Installation of new valves enables testing of reactor buildings CC penetrations with air. Installation of new valves in the pipe system required modifications of the pipe supports. During the operation of the NPP these valves are locked in open position.

3. Modification 359-RC-L
According to the requirements of the Regulatory Guide 1.97, two additional Steam Generator (SG) wide range level measuring loops were installed. Standard measuring of the level in closed vessel under pressure was used with the help of a reference column with two converters which will measure the differential pressure. Measurement is continuous and covers 14620 mm of SG range from 0% to 100%. The values of additional trains are displayed on a 4-channel recorder which displays a wide range of SG levels on the MCB (Main Control Board), section C. The new recorder replaced the old 2-channel recorder.

4. Modification 339-RC-L
"Modernisation of the system for reactor pump inspection of vibrations (RCP vibration monitoring)". With this modification the analyser Bruel&Kyaer was removed and a new box with the control system Bentley Nevada was installed in the DEH. The sensors with a pre-amplifier of absolute values were reconnected to the new system (7 measuring channels per each pump). Surveillance was expanded with the installation of new measuring channels for measurement of relative moving of axis and measurement of speed (8 measuring channels per

each pump). The configuration of the alarms on the MCB was kept in the same function, but the possibilities of diagnostics expanded. The new surveillance system will collect data in real time and observe, store and alarm whenever the values exceeded the limitations (alarm, trip).

5. Modification 248-VA-S
»Pressure Regulation in the Auxiliary Building (AB)«. The modification improves the control of permanent negative pressure in the A-band operating of the PCV 6635 valve. A controller with the possibility to set the values (set-point) with the non-active range (dead-band), was installed, which ensures stabile operation of the valve by switching off its permanent cyclic operation.

6. Modification 355-VA-L
The »HEPA Exhaust Flow«. Loop F-7040 was reconfigured with the installation of a new pneumatic controller FIC 7040, which is connected with FT 7040. All control functions are performed by this controller; it makes better surveillance of control dumpers and allows regulations at the place of manipulation.

7. Modification 372-CT-S
"Replacement of instrumentation for monitoring of temperatures CT –pumps". Two displays of temperatures (for every pump) were replaced. New Yokogawa digital displays were installed. The sensors and the installation remain the same.

8. Modification 376-FP-S
"Replacement of the west part of the hydrant system". In the project of replacement of the whole hydrant system piping with new HDPE, the pipes from valve V3 and V3A were changed (the west part of the facility, between the building for decontamination and the intermediate and the auxiliary building (IB and AB)). Both isolation valves and all hydrants at this location were also replaced.

9. Modification 361-HD-S
"Automatic control of the seal water pump Heater Drain System (HD) flux". The aim of the modification was to bring together all performed and temporary small modifications on HD and evaluate them as permanent modifications. These include new time relays for Hi-Hi level on Feedwater System (FW) on heaters No. 2B and 6B. According to the original project design, a PIC controller was installed in the seal water line HD, regulated default values on some level switches were put in order, and the drain check valve at heater 2B is operable again.

2.1.2.4 Other implemented modifications

1. Modification 357-RC-S
»Modernisation of Large Bore Snubbers of SG«.

2. Modification 354-RC-L
»Subcooling monitor alarm of RCS after reactor shutdown«.

3. Modification 095-GN-S
»New CO_2 station for exchanging atmosphere in the main generator«.

4. Modification 344-CK-S
»Replacement of the compressor cooling (CK) and installing on WT system«.

5. Modification 257-SY-L
»Replacement of transmission line protection on transmission line NEK – Tumbri I«.

6. Modification 358-CH-L
»Assurance of uninterrupted operating of PIS system (PIS level 1 UPS Sources)«.

7. Modification 219-CH-L
»Transfer of PIS data to Ljubljana (ERDS&EOF)«.

8. Modification 254-CH-L
»Integration&Connection of a technological computer net«.

9. Modification 269-HC-S
»Replacement of oxygen cylinders (O2) on HC system«.

10. Modification 265-XP-S
»Alternative power supply for auxiliary station transformer T3«.

2.1.3 SPENT NUCLEAR FUEL

All spent nuclear fuel from the Krško NPP is stored in a pool. Around two thirds of the pool are occupied by racks with 828 positions for storing spent nuclear fuel. After the outage in 2001, 36 fuel assemblies were removed from the core. At the end of 2001, 630 fuel assemblies were stored in the pool (around 258 tonnes of heavy metal). The remaining free positions for further storing of spent fuel assemblies, including the possibility of storing the entire core, suffice for only 2 more years of operation of the Krško NPP.

The Krško NPP is planning a modification of the pool in order to enable further undisturbed operation until the operation licence has expired in 2023. In accordance with analyses and projects given to the SNSA in 2001, all spent fuel that will be produced by the end of the planned plant's life-time (40 years) can be stored in the pool.

Data on the number of spent fuel assemblies in the Krško NPP are given in the Table 2.12.

Table 2.12: Data on the number of spent fuel assemblies in the Krško NPP.

Year	Stored in the pool	Taken from the core
1983	40	40
1984	82	42
1985	122	40
1986	154	32
1987	194	40
1988	226	32
1989	266	40
1990	314	48
1991	314	0*
1992	358	44
1993	406	48
1994	406	0**
1995	442	36
1996	470	28
1997	498	28
1998	530	32
1999	562	32
2000	594	32
2001	630	36

*   There was no replacement of the fuel in 1991
** In 1994, the outage started in December, the fuel was replaced in January 1995

2.1.4 RADIOACTIVE WASTE

During the operation of the Krško NPP, different radioactive substances in liquid, gaseous and solid form are generated. These radioactive substances are processed in the system for radioactive waste. The system is constructed for collecting, processing, storing and packaging of waste in a suitable form and in such way that it minimises releases into the environment. Three fundamental systems are used for radioactive waste management. one for liquid, one for solid and one for gaseous radioactive waste.

In the year 2001, the Krško NPP updated its radwaste database which includes the following information for each stored package:

- ordinal number,
- category and type (with data on physical-chemical and radiochemical composition)
- date of generation
- quantity
- volumetric mass
- specific activity
- contact dose rate
- dose rate at 1m distance
- activity of all isotopes with correction on decay
- total alpha activity
- date and place of storing

a) Radwaste which was stored in the year 2001

In the year 2001, 217 standard 200 L drums with solid LILW were stored with a total activity of 4,432.04 GBq, as shown in Table 2.13

Table 2.13: Type of LILW stored in the year 2001.

Type of waste	No. of drums	Activity [GBq]
EB-DC	18	285.4
CW	100	46.83
O	60	17.87
SR-PR	21	4019
SR-BR	15	34.09
F	3	28.85
Total	217	4,432.04

Type of waste:

EB-DC	dried evaporation bottoms
CW	compressible waste
O	other
SR-BR	dried spent blow-down resins
SR-PR	dried spent primary resins
F	filters

From the beginning of its operation until the end of 2001, the Krško NPP produced 13,587 standard drums (210 L) of LILW amounting to 2,853.2 m^3. Figure 2.34 shows the annual production of radioactive waste by type. Each column (see legend) represents, from the bottom to the top, production of CW, followed by EB, O, SR and F production.

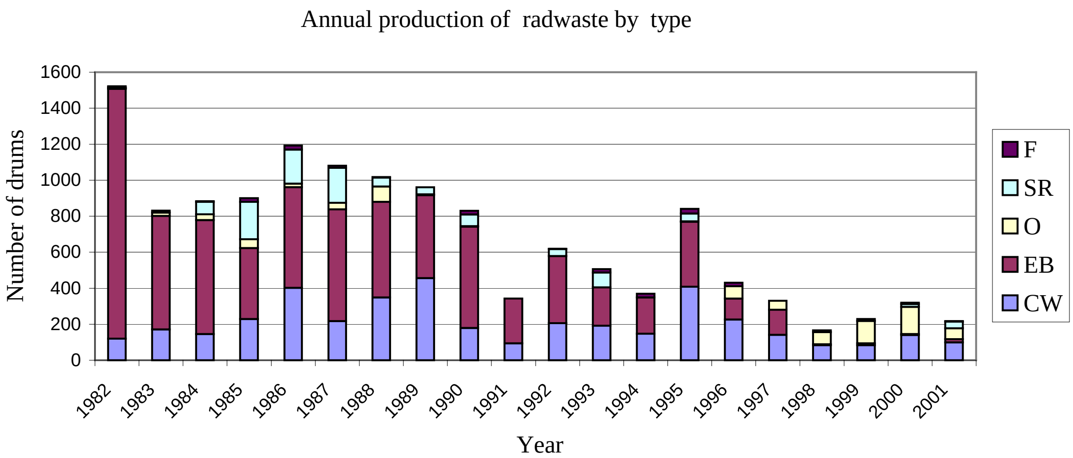

Figure 2.34: Annual production of LILW by type at NPP Krško.

In the previous years, the volume of generated waste was reduced by using the following methods: compaction, supercompaction, drying and incineration. At the end of the year 2001, the volume of stored waste at the Krško NPP was 2,207.5 m^3. Figure 2.35 shows commutative balance of the LILW in the storage of the Krško NPP. The figure also shows volume reduction due to compaction, supercompaction and incineration. Slower growth of production of the LILW after the year 1995 is the result of introduction of a new system for drying evaporation bottoms and spent resins and temporary storing of spent resins in "RADLOC" containers.

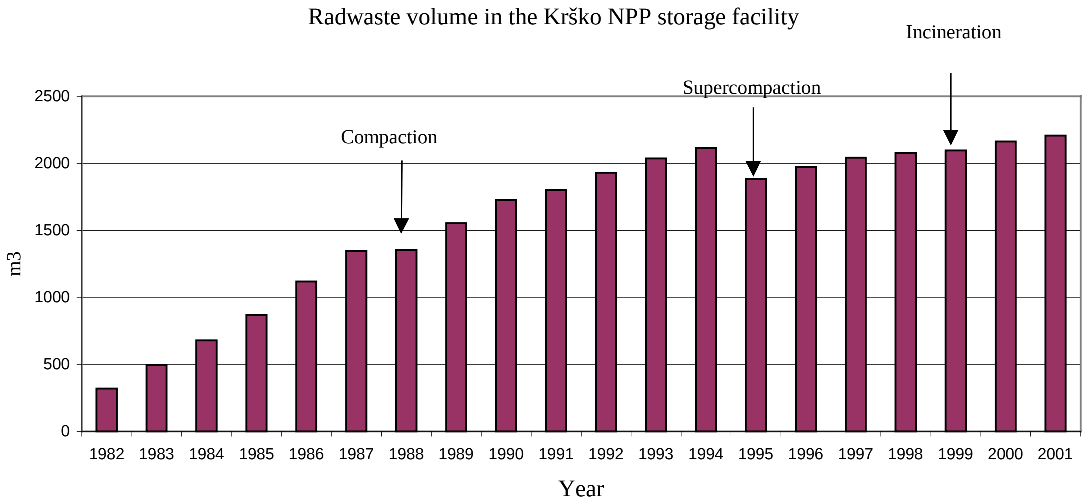

Figure 2.35: LILW volume in the NPP Krško storage facility.

Table 2.14 presents the actual quantities of waste at the end of the year 2001, namely: types, amounts, activity calculated on the basis of dose rate at a distance of 1m, specific activity and dose rate at the surface of a drum.

Table 2.14: State in the storage facility at the Krško NPP at the end of the year 2001.

Type of waste	No. of drums	Activity [GBq]	Volume [m^3]	Specific activity [GBq/m^3]	Radiation level [micro Sv/h]	
					from	to
SR	689	16,130	144.7	111.5	5	100,000
CW	583	666.8	122.4	5.4	5	40,000
EB	251	260.3	52.7	4.9	50	3,000
F	108	2,101	22.5	93.5	20	50,000
O	498	239.6	104.6	2.3	5	15,000
A	33	2.8	6.9	0.4	20	100
SC	617	531	197.4	2.7	10	25,000
ST	1,753	6,784	1,514.6	4.5	0.9	70,000
TI	36	6,984	31.3	223.2	50	200,000
TTC	12	1.6	10.4	0.2	10	200
Total	4,580	33,701.1	2,207.5	15.2	0.9	200,000

Type of waste:

SR - spent resins
CW - compressible waste
EB - evaporation bottoms
F - filters
O - other
SC - compacted waste in 1988 and 1989
A - incineration products
ST - compacted waste in 1994, 1995 and 387 non-compacted standard drums inserted in TTC
TI - drums from IDDS inserted into TTC
TTC - inserted 200 L drums in TTC

b) Temporary storing of spent resins in "RADLOC" containers

In the storage facility in HIC (High Integrity Containers) RADLOC-500 spent resins are temporarily stored and are waiting for processing in the IDDS system (system for drying of radioactive waste). There are six containers with 17 m^3 of spent resins from the primary circuit and four containers with 9.4 m^3 of blow-down spent resins. All blow-down spent resins should be treated by IDDS technology between the years 2002 and 2003 and spent resins from the primary circuit between 2004 and 2007. This was proposed in the technical report *"Radioactive waste management at the Krško NPP, Rev.1"*, prepared in 2001. The SNSA is considering this issue now because the RADLOC-500 containers have not been included in the Safety report of the Krško NPP and the above-mentioned storing in RADLOC containers does not comply with the Safety report.

c) Temporary storing of contaminated waste oil

In the Krško NPP storage facility, 30 drums of different types of contaminated waste oil have been temporarily stored. The contaminated waste oil is stored in 200 L drums and additionally protected within several EKO-type containers which are protected against spilling. The specific activity of the oil varies from 110 to 95,900 Bq/L. The prevailing radionuclides are

Co-60 and Cs-137. The Krško NPP is considering an adequate method of treatment of the contaminated waste oil. The most contaminated waste oil from a few drums and some tens of litres of organic liquefies are planned to be solidified by a special solidification substance produced by the US company Nochar. This was also proposed in the technical report "Radioactive waste management at the Krško NPP, Rev.1". The major part of the oil should probably be shipped in the liquid phase for incineration. As the quantity increase of contaminated waste oil is relatively low (less than 100 L per year), the Krško NPP will probably solidify all contaminated waste oil and subsequently send it for incineration. The SNSA is still considering also this issue.

d) Temporary export of radioactive waste due to its incineration to Sweden

In November 2001, the Krško NPP asked for a permit for temporary export of radioactive waste (types: compacted waste - CW and other - O) which will be incinerated at the Swedish enterprise Studsvik RadWaste. The radioactive waste was packed in standard drums but it was not sorted. The main radionuclides were Co-60, Co-58, Cs-137 and Cs-134. The total mass of the radioactive waste, packed in 250 standard drums, was approximately 21 tonnes. The average activity of the drums was 8.2 MBq. The total activity of the shipment on 16 November 2001 was 2,051 GBq. The export is scheduled to be performed in the first half of the year 2002.

e) Radioactive waste, stored in the Decontamination Building

In the year 1999, a special facility was constructed for the storing of two old steam generators – the so-called Decontamination Building consisting of three rooms:

- decontamination area
- "mock-up" area, and
- area for storage of old steam generators

In the area where both steam generators with the activity of 3000 GBq have been stored, additional 7 containers with thermal insulation and other parts which had been produced during the steam generators replacement, were stored at the end of the year 2001. During the outage in 2001, a heat exchanger was removed which has also been stored in special containers in this area. The surface dose rate is up to 3.5 mSv/h. Additionally, four steel boxes with contamination tools, seals of cover, equipment of Framatome and two wooden boxes with contaminated equipment have been stored in the same area. In the decontamination area, tools for manipulation with fuel assemblies with surface contamination of 4,000 Bq/dm^2 and a crusher were stored at the end of 2001.

2.1.5 RADIOACTIVE RELEASES FROM THE KRŠKO NNP IN THE ENVIRONMENT

The limits of radioactive releases into the environment are stipulated by the licence for operation of the NPP Krško No. 31-04/83-5, issued on 6 February 1984 by the Energy Inspection Authority of the Republic of Slovenia.
The competent authorities were regularly informed about the releases of radioactive materials in the environment of the Krško NPP on a daily, weekly, monthly, quarterly and yearly basis.

2.1.5.1 Liquid releases

The liquid radioactive releases are discharged into the Sava river through the main water supply in front of the dam. The activity of liquid releases indicates that the dominating radionuclides are: Xe-133, Xe-135, Xe-131m, Xe-133m, Kr-85, Co-60, Fe-59. The activity of Cs-134, Cs-137, Co-58 and Sb-125 is by two to three orders of magnitude lower. The main contribution to the dose is made by the radionuclides caesium and cobalt. The concentrations of each radionuclide in the liquid releases are measured and controlled by reactivity meters. These automatically close the local valves once the prescribed limit concentration is reached, and thus prevent further releases into the environment. In liquid releases, the dominating radionuclide was tritium (H-3). Even though the activity of tritium is high compared with other radionuclides, due to it's low radiotoxicity its impact is insignificant. In 2001, the annual released activity of this radionuclide was 7.75 TBq, which was approximately 38.8% of the annual limit value of 20 TBq. Figure 2.36 presents the changes of the aggregate activity of tritium in releases over several years. The annual activity of other radionuclides in liquid releases was about a thousand times lower, and is shown in Figures 2.37, 2.38, 2.39, 2.40 for the entire period of the Krško NPP operation. The releases for the year 2001, compared to average released activity over the years, were significantly lower, due primarily to stable power plant operation and suitable waste water decontamination systems.

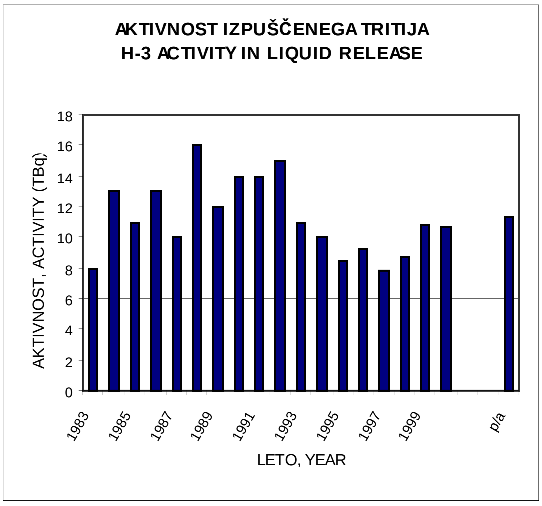

Figure 2.36: Tritium activity in liquid releases (administrative annual limit 20 TBq).

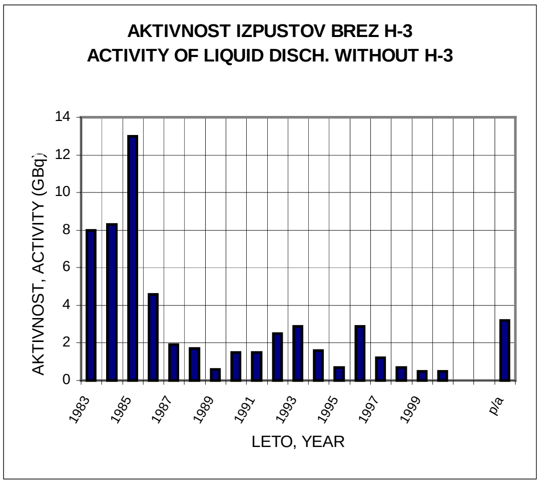

Figure 2.37: Fission and activation products activity in liquid discharges without tritium.

Figure 2.38: Co-60 activity in liquid releases.

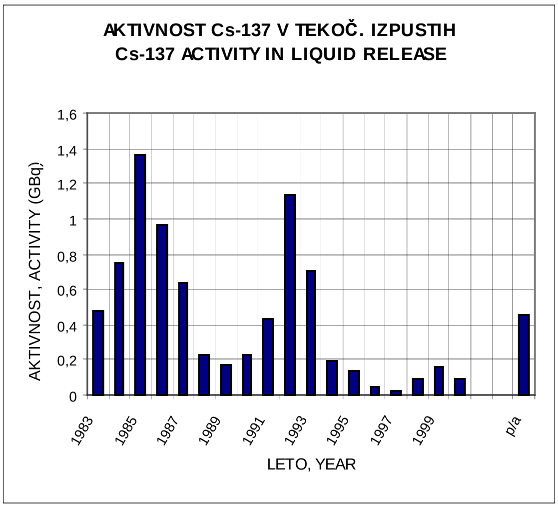

Figure 2.39: Cs-137 activity in liquid releases.

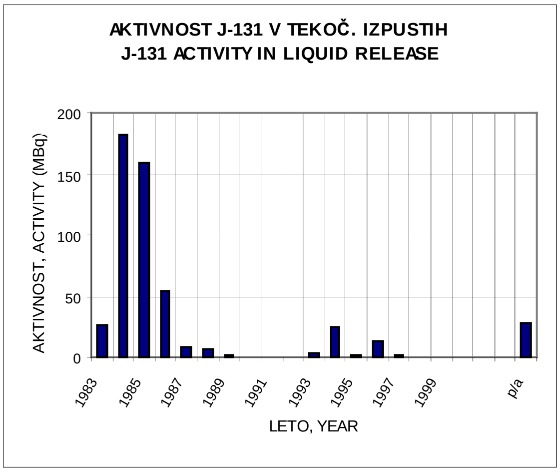

Figure 2.40: I-131 activity in liquid releases.

2.1.5.2 Gaseous releases

Radioactive gases from the Krško NPP were released into the atmosphere mainly from the reactor building stack and through the vent of the condenser in the secondary coolant loop. The radiation monitoring system continuously measures and controls concentrations of individual radioactive elements at both discharge points.
The release activities and the limit values for all important gaseous emissions in 2001, where the activity of noble gases prevails, are given in Table 2.15. In 2001, the radioactivity of noble gases, mostly short-lived isotopes of Kr and Xe, was 2.11 TBq (Xe-133 equivalent), which represents 1.9% of the annual limit value. The low values of gaseous releases in the last few years has been expected due to the fact that there was no significant fuel leakage in the reactor core. Most of the release occurred during the outage. Figure 2.41 presents changes in total activity of noble gases in discharges, Figure 2.42 the activity of C-14 in atmospheric discharges and Figure 2.43 the activity of H-3 in atmospheric discharges for each year. Figure 2.44 shows the discharge of noble gases in the year 2001.

Emissions of radio iodine in the year 2001 were 129 MBq (I-131 equivalent)., which amounts to 0.0007% of the annual limit. Most of this was released during the outage, so a considerable increase of radio iodine in gaseous releases was observed in May, which was due to the opening of the primary system (reactor vessel, steam generators); this is normal and was expected. Figure 2.45 shows the released activity of radio iodine for each month in 2001.
The activity of other radionuclides in aerosol releases is lower by several orders of magnitude due to efficient filtering in the main ventilation channel. The released activity in the year 2001 was 2.83 MBq, which is 0.015%of the annual limit. H-3 and C-14 emissions are constant and in the year 2001 NPP Krško released 0.86 TBq of H-3 and 0.11 TBq of C-14. Figure 2.46 presents the released activity of tritium, and Figure 2.47 the activity of C-14 for each month in 2001.

Table 2.15: Gaseous releases activity in 2001.

Gaseous emissions	Released activity [Bq]	Limit values of emissions (Bq/year)	Limit value percentage [%]
Noble gases	2.11 E +12 (Xe-133 equiv.)	110 E+12 (Xe-133 equiv.)	1.9
Iodines	0.13 E+06 (I-131 equiv.)	18.5 E+9 (I-131 equiv.)	0.0007
Aerosols	2.83 E+06	18.5 E+9	0.015
Tritium	0.86 E+12	no restriction in TS*	
C-14	0.11 E+12	no restriction in TS*	

*TS - technical specifications

According to the technical specifications for the Krško NPP the annual limits for releases are as follows:
the limit value for the activity of released noble gases is 110 TBq, equivalent to Xe-133 per year,
the limit value for the activity of radio iodine in gaseous releases is 18.5 GBq, equivalent to I-131 per year;
the limit value for aerosols in gaseous releases with a decay time of more than 8 days is 18.5 GBq per year,
there are no explicitly specified limit values for tritium and C-14 in gaseous releases.
The activity of gaseous releases is indirectly restricted by dose/ concentration limits at the Krško NPP fence.

Note: In Figures 2.37 and 2.38 an estimate for the Krško NPP is given for the period 1983-1990, based on periodical measurements of concentrations and flows, and - from 1991 onwards - an estimate by the JSI is given, derived from results of continuous measurements.

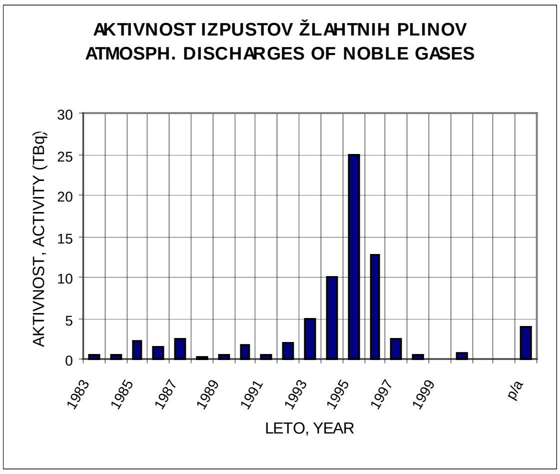

Figure 2.41: Noble gases activity in gaseous emissions since 1983.

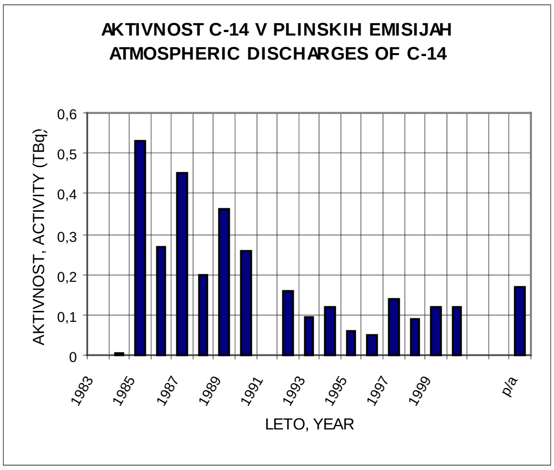

Figure 2.42: C-14 activity in gaseous emissions since 1983.

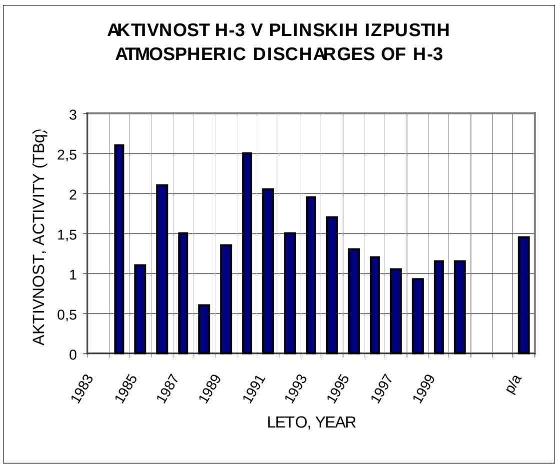

Figure 2.43: H-3 activity in gaseous emissions since 1983.

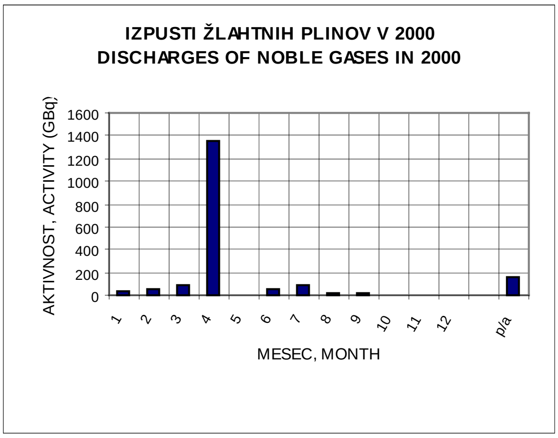

Figure 2.44: Noble gases activity in gaseous emissions in the year 2001.

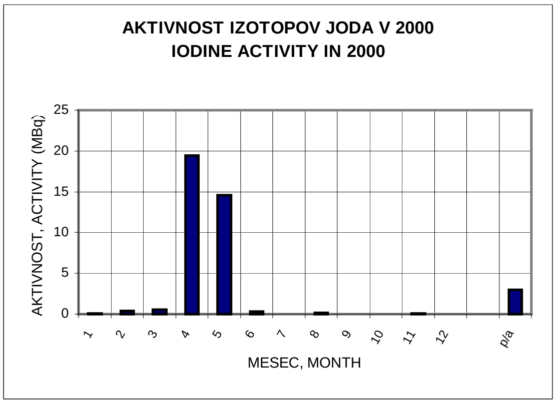

Figure 2.45:Radio iodine activity in gaseous emissions in the year 2001.

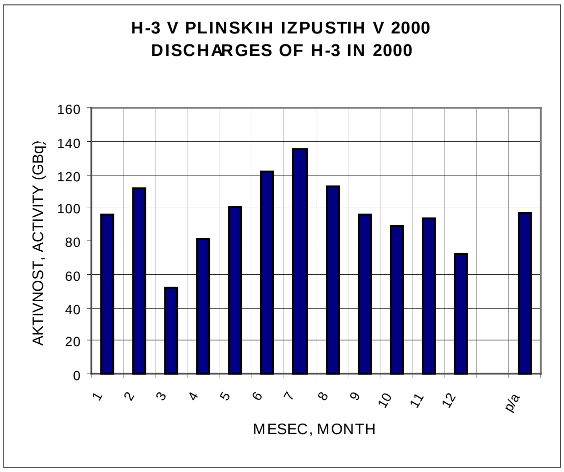

Figure 2.46: H-3 activity in gaseous emissions in the year 2001.

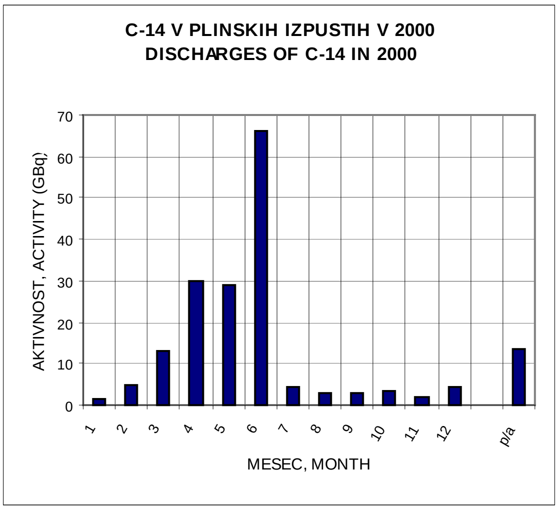

Figure 2.47: C-14 activity in gaseous emissions the year 2001.

Source:

– Periodical and annual reports of the NPP Krško and reports of authorised organisations.

2.1.6 THE KRŠKO NNP PERSONNEL EXPOSURE TO RADIATION

The Radiological Protection Unit (RPU) at the Krško NPP was organised for the purpose of measuring, calculation and regular recording of received effective doses for all workers who have access to the controlled area of the power plant, regardless of whether they are members of the NPP staff or external contractors, inspectors and visitors.

From the viewpoint of radiological protection, the power plant area comprises the area under constant radiological surveillance and the area where the radiological surveillance is carried out either periodically or according to needs. The area under constant radiological surveillance (the controlled area) consists of: the reactor building, the fuel handling building, the auxiliary building, a part of the intermediate building, the primary laboratory, hot machine shops, the decontamination area, a part of the building for decontamination and areas for processing and storing of radioactive wastes.

In the area under radiological surveillance – where irradiation and contamination is highly probable – the Krško NPP staff or external contractors must carry with them personal dosimeters in addition to the regular protection equipment. Personal dosimeters are designed for surveillance of exposure to external radiation, and measure the total received dose in a given period. Internal radiation – or the so called internal contamination – is measured in the Krško NPP by the whole-body counter (WBC). Measurements of internal contamination are carried out for all workers working in the radiologically controlled areas where there is a risk of irradiation and contamination (annual outages or major maintenance) before and after work. For daily recording and control of received doses during work at the Krško NPP, digital alarm personal dosimeters are used. However, for monthly recording of official doses thermoluminiscent personal dosimeters (TLD) are used.

The average exposure of workers to ionising in the NPP is low. In 2001 the average effective dose to workers was 1.27 mSv, which is approximately 2.5% of the dose limit to workers who are professionally exposed to ionising radiation (the still valid Regulations on Dose Limits to Population and Radiation Workers, Individual Monitoring and Monitoring of the Workplaces, (Off. Gaz. SFRY, No. 31/89) or 6.3% in accordance with the latest recommendations of ICRP-60 (1991) and EU-BSS (1996).

The average effective dose to the NPP personnel was 0.61 mSv, and to external workers 1.71 mSv. Workers received the major part of the dose during the annual outage of the power plant. It has been found out that in the recent years the average individual and collective doses have shown a rising trend from 1997 to 2000 as a consequence of the major works performed at the primary systems of the nuclear power plant, however, in the year 2001 these doses are significantly lower.

In Table 2.16 the distribution of effective doses to workers in the Krško NPP for the entire period of its operation is shown. In the year 2001, 3 NPP workers received annual effective doses of more than 5 mSv, all of which were lower than 10 mSv. Of the external contractors, 51 received effective doses above 5 mSv, of which 10 contractors received effective doses above 10 mSv. An effective dose higher than 15 mSv was received by 2 workers from the company Inetec Zagreb. The highest effective dose in the Krško NPP for the year 2001 was 15.81 mSv.

The dose values given in Table 2.17 refer to workers who received effective doses above 5 mSv, specifying the type of work performed and the category of the personnel. It has been found out that the most exposed workers are maintenance workers during the annual outage of the power plant.

Table 2.18 shows that in 2001 the collective effective dose to workers at the Krško NPP was 1.13 mSv, which is the lowest value in recent years (2000 – 2.60 manSv, 1999 – 1.65 manSv, 1998 – 1.25 manSv). The collective effective dose in 2001 is lower than the average value for the whole period of commercial operation of the Krško NPP from 1983 to 1999, which is 1.56 manSv (Figure 2.48). Lower effective doses are due to plant upgrade and the modernisation programme performed in recent years. In 2001, the collective dose to the Krško NPP staff was only 0.21 manSv, and to the external contractors and the main supplier workers 0.92 manSv.

In 2001, the collective effective dose per unit of net electrical energy produced was 1.88 manSv/GWyear, which is the lowest value in recent years (2000 – 4.78 manSv/GWyear, 1999 – 3.22 manSv/GWyear, 1998 – 2.28 manSv/GWyear). The distribution of the received effective doses in the Krško NPP from 1983 to 2001 is presented in Figure 2.49. The effective dose was the lowest in 1991. In 2001, there was no refuelling and, therefore, the annual outage was shorter.

In 2001 no radiological events (specially authorised exposures, exposures due to incidents) at the Krško NPP occurred to cause unplanned exposure of the workers, either from external radiation or from internal or external contamination.

The Krško NPP regularly submits annual reports on radiological events and doses received by its workers to the international organisation OECD/NEA International System on Occupational Exposure (ISOE). Two representatives of the Republic of Slovenia are involved in the work of ISOE, one from the Krško NPP and one from the SNSA.

The members of the organisation have at their disposal:

- An extensive and updated data base on occupational exposure in nuclear power plants and on methods for the best possible radiological protection of workers,
- A mechanism for the analysis and evaluation of collected data to help anticipate trends and identify critical areas, by applying the principle of optimised protection (ALARA),
- Access to organisations and experts with expertise on protection of occupationally exposed workers and on reducing their doses.

Taking into account the systematic prevention work to minimise the workers` exposure (education, training for specific tasks in the radiation area and suitable planning of operations in compliance with the ALARA principle), as well as the knowledge and experience of ISOE, it can be expected even lower collective doses for the Krško NPP in the following years.

A comparison between the collective doses in the Krško NPP and the average collective doses for PWR plants in the world since the year 1990 is given in Figure 2.50. The collective effective dose for the year 2001 in the Krško NPP is also added to the comparison, as well as the expected value for the year 2002.

Table 2.16: Distribution of effective doses for all workers at the Krško NPP in 1981-2001.

Year	Range of received annual effective doses [mSv/year]							Total number of workers
	0-1	1-5	5-10	10-15	15-20	20-25	Over 25	
1981	475	45	0	0	0	0	0	520
1982	275	313	9	13	10	1	1	622
1983	462	206	53	45	34	27	4	831
1984	375	205	15	3	2	0	0	600
1985	517	277	79	17	2	0	0	892
1986	524	301	79	3	4	1	0	912
1987	486	242	65	16	6	1	0	816
1988	506	298	60	21	3	1	0	889
1989	443	200	66	19	3	0	0	731
1990	390	265	92	38	5	2	0	792
1991	257	89	8	0	0	0	0	354
1992	448	219	0	127	22	1	0	817
1993	401	183	87	26	9	1	0	707
1994	536	187	32	2	0	0	0	757
1995	521	248	62	16	3	0	0	850
1996	489	258	114	25	3	0	0	889
1997	559	211	46	5	0	0	0	821
1998	560	221	72	6	0	0	0	859
1999	578	297	97	11	0	0	0	983
2000	588	389	106	29	15	4	0	1131
2001	579	254	44	8	2	0	0	887

Table 2.17: Collective effective dose for NPP staff, the main supplier workers and the external contractors in the Krško NPP in 2001 and the number of workers who received doses higher than 5 mSv, with regard to the type of work and personnel.

Job/personnel	Number of workers who received a dose above 5 mSv			Collective dose [manSv]		
	1*	2**	3***	1*	2**	3***
Normal reactor operation and supervision						
Maintenance personnel				0.01329		0.02551
Operators				0.00404		
RPU personnel				0.00619		
Inspection personnel				0.00154		
Regular maintenance works						
Maintenance personnel	2	2	49	0.08191	0.05892	0.82834
Operators				0.04559		
RPU personnel				0.02110		0.00321
Inspection personnel				0.01086		
Inspection of equipment before start						
Maintenance personnel						
Operators						
RPU personnel						
Inspection personnel						
Extraordinary maintenance						
Maintenance personnel						
Operators						
RPU personnel						
Inspection personnel						
Processing of radioactive wastes						
Maintenance personnel						
Operators	1			0.01453		
RPU personnel						
Inspection personnel						
Refuelling of the reactor						
Maintenance personnel						
Operators				0.01534		
RPU personnel						
Inspection personnel						
Total						
Maintenance personnel	2	2	49	0.09520	0.05892	0.85385
Operators	1			0.07950		
RPU personnel				0.02729		0.00321
Inspection personnel				0.01240		
TOTAL	3	2	49	0.21439	0.05892	0.85706

1* Nuclear object personnel
2** Main equipment contractor
3*** Other personnel

Table 2.18: Collective and average effective dose to workers in 2001.

	Collect. effect. Dose [manSv]	Number of workers	Average dose [mSv]
Krško NPP staff	0.21	352	0.61
Contractors	0.92	535	1.71
Total	1.13	887	1.27

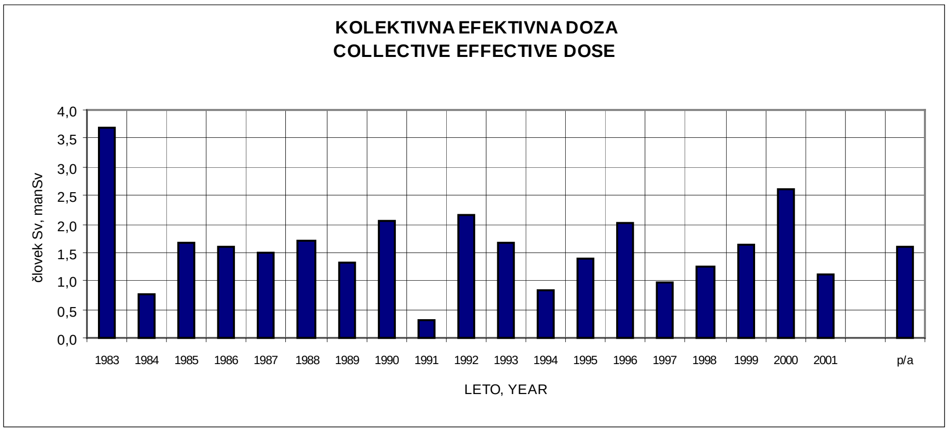

Figure 2.48: Received collective effective doses by all workers at the Krško NPP per year.

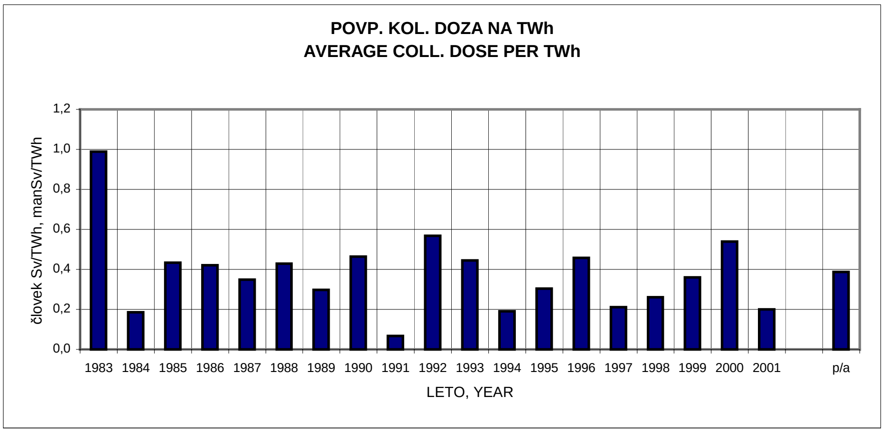

Figure 2.49: Collective effective dose per unit of produced electrical energy.

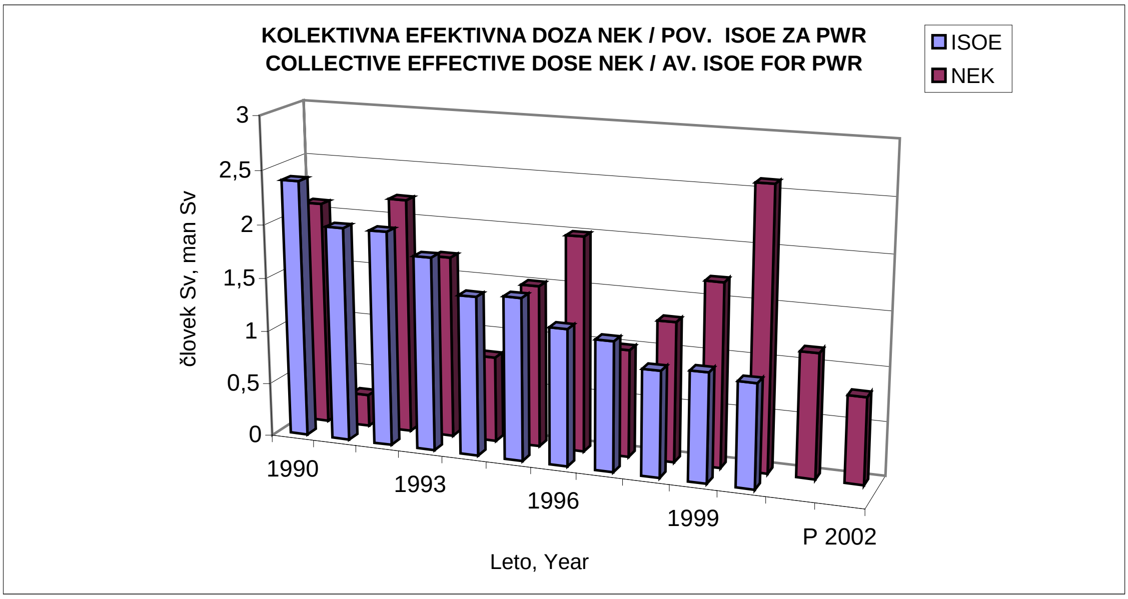

Figure 2.50: Comparison between the collective doses in the Krško NPP and the average collective doses for PWR plants in the world since 1990.

2.1.7 TRAINING

The annual training plan for the year 2001 was developed on the basis of needs identified by plant organisational units. The documented requests were analysed and evaluated by the heads of organisational units and plant management. The training plan was developed in accordance with training program requirements, described in Chapter 13.2 of the Safety Analysis Report, and with the administrative plant procedure ADP-1.1.009, Training and Professional Education of NEK Personnel.

With increased internal training capabilities during the year 2000, the amount of domestic training for operations and maintenance personnel significantly increased in 2001. Some special training needs were covered using outside resources, domestic and foreign, e.g. those of WANO.

There were no major obstacles during the realisation of the training plan for the year 2001.

All the training that was planned for licensed personnel, personnel with duties related to nuclear safety and personnel required to receive re-qualification training in accordance with domestic regulations, was smoothly performed and completely covered as planned for the year 2001.

The most important training activities, outlined consistently with the training program structure and training areas, are further described in more detail.

2.1.7.1 Initial training

a) Operations personnel initial training

Operations personnel initial training consists of training conducted for the candidates for operator licenses and for the persons filling various positions in operations, or for other areas where additional knowledge is required.

In September 2000, 11 trainees started with the basic course of Nuclear Power Plant Technology. The theoretical part was finished at the beginning of February 2001. The group of candidates continued training with lectures on NPP Krško plant systems. This part consisted of classroom presentations and practical training at the plant. From this group, 8 candidates were selected for further training on the NPP Krško full scope simulator.

In December 2001 training started on the NEK simulator and in the main control room and will be finished in October 2002.

In the year 2001 one participant attended training for the Shift supervisor, three participants for the Senior Reactor Operator, two participants for the Balance of Plant Operator and two participants for the Field Operator.

As part of co-operation between NEK and the WANO association, two participants attended the "Shift Manager Professional Development Seminar" and "Engineering Supervisor Professional Development Seminar".

b) Other technical personnel initial training

Additional training for other technical personnel consisted of training courses aimed to provide additional general and special knowledge needed in the maintenance area and for other support functions.

The maintenance training instructor group prepared and conducted a series of courses for the maintenance personnel. The quality and quantity of training for the maintenance personnel significantly increased by putting in function the training centre for maintenance personnel.

Additional general training was provided to a large number of NEK personnel to assure high quality performance during the outage 2001. General employee training and radiation protection training was provided to a high number of contracted maintenance personnel as well.

2.1.7.2 Continuous Training

a) Operations personnel continuous training

Operations personnel continuous training consists of programs that are regularly conducted in accordance with regulatory requirements to retain the main control room operators licenses as well as licenses for field operators.

b) Licensed personnel training

A continuous training program for the licensing of personnel was approved by the SNSA. The training program was adopted in the annual plan 2001 for training of NEK personnel and was prepared according to the requests of the Regulation on education, experience, examination and certification of personnel conducting specific work in nuclear facilities. The training also followed the Regulations of Occupational Safety and Work with Ionising Radiation.

The entire retraining program is designed as a two-year cyclic program divided into eight weekly training segments and each year four segments are conducted. Eight teams participate in each training segment. Each segment consists of 15 hours of classroom presentations and 20 hours of simulator exercises. Operational teams therefore receive 80 hours of simulator training, which is comparable to the practice in developed countries. One Shift crew participated in the work on the simulator in the exercise "Emergency measures in the case of abnormal events". In 2001, the training program on the simulator consisted of different scenarios for normal plant operation, abnormal plant behaviour, equipment failure, design bases accidents and accidents beyond the design bases.

In autumn 2001, 11 candidates passed the examination for acquisition or renewal of a license for reactor operator or senior reactor operator. Eight candidates renewed the senior reactor operator license, and one candidate acquired the senior reactor operator license for the first time. Two candidates renewed the reactor operator license. Written exams were prepared, selected and marked by the members of a special commission of experts appointed by the SNSA. In addition to the written exam, a practical operating exam was also conducted on the NEK simulator. Examination scenarios on the simulator were prepared in advance and were selected for each group separately. The simulator examination was performed in accordance with the NEK training procedure TSD-13.409 (in Slovene: "Izvajanje preizkusov usposobljenosti na simulatorju"). The group of examiners was composed of experts nominated by the SNSA, operations department management and instructors.

c) Other technical personnel continuous training

Training courses in this area are aimed to refresh and upgrade knowledge in different areas as required by regulations and needs for working processes in NEK. The following training courses were organised: First Aid, Work in a High-risk Explosive Environment, Fire Protection, Occupational Safety and Dangerous Substances.

Training related to emergency preparedness at NEK was conducted in accordance with procedures for emergency preparedness - NUID. A larger scale exercise was conducted in October 2001 and was supported by the NEK full scope simulator.

In co-operation with WANO, three courses for the needs of instructors training were organised: "Instructor Skills Course", "Advanced Simulator Instructor Course" and "Improving Human Performance".

A large number of general employees courses and radiation protection courses were conducted for NEK employees and subcontracted personnel. Basic training for RZ-2 (radiation protection level 2) was successfully passed by 24 NEK employees and 21 subcontractors. Retraining on RZ-2 (radiation protection level 2) was completed by 49 NEK employees and 6 subcontractors. Basic training and retraining (15 basic and 2 retraining courses) on RZ-3 (radiation protection level 3) was completed by 5 NEK employees and 132 subcontractors. General employees training for NEK specifics was completed by 697 subcontractors. Training and courses on radiation protection in the year 2001 were mainly a preparation for the annual outage.

2.1.8 INSPECTIONS AT THE KRSKO NPP

In the year 2001, SNSA inspections were carried out in accordance with the approved inspection programme in the Krško NPP: 84 regular - announced inspections, 1 irregular inspection (related to the control of reactive power of the diesel generator) and 1 inspection related to the arrival of the fresh fuel to the port of Koper). Four regular inspections of the Krško NPP were conducted in co-operation with other inspections: two with the Health Inspectorate of the Republic of Slovenia, one within the framework of the Commission for technical survey of new installations in the Krško NPP and one with the IAEA inspection in the field of non-proliferation of nuclear weapons.

The SNSA representatives co-operated at the inspection of the Ministry of the Interior that was carried out at the Krško NPP (topic – physical protection).

Routine inspections at the Krško NPP in 2001 were performed on average twice a week and comprised, depending on the plan of work, the following:

a) Operation:
- review of the implementation of the decisions of SNSA,
- survey of data on the nuclear fuel status (leakage, fuel burn up at the end of the 17th fuel cycle),
- design of the new reactor core for the 18th fuel cycle,
- primary coolant activity during and at the end of the 17th fuel cycle,
- keeping the logbooks by the operating personnel,
- preparations for the 2001 outage,
- status/changes of the valid revision (Rev. 10) of the Emergency Operating Procedures after the implemented modifications and power uprate,
- status/changes of the valid revision (Rev. 11) of the Abnormal Operating Procedures after the implemented modifications and power uprate,
- status/changes of the General Operating Procedures,
- walkdown of the engineered safety systems,
- modifications during outage and during operation,
- measures for improving housekeeping in the areas of technology process,
- preparation of the power plant for operation in winter time.

b) Radiological control:
- doses received by personnel during the Outage 2001 (collective, individual),
- doses received by subcontractors during the Outage 2001,
- performance of training in the field of radiation safety,
- inspection of the ALARA programme for the Outage 2001,
- decontamination unit performance,
- increase of the dose rate on the surface of the water in the spent fuel pit due to release of Cobalt – 58 and Cobalt – 60 of the fuel elements surface,
- radwaste management, taking out of the controlled area, housekeeping in the decontamination and old steam generators building.

c) Maintenance and surveillance testing:
- On-line maintenance and accompanying activities (PSA, planning, work orders),
- implementation of the 10 CFR 50.65 Maintenance Rule – surveillance of the level of maintenance,
- periodic witnessing of the regular monthly testing of diesel generators for emergency power supply,
- measurement of total reactive power,

- testing of a new main transformer,
- surveillance testing of battery chargers and battery elements,
- review of results of the surveillance testing of safety injection pumps,
- review of results of the surveillance testing of the auxiliary feedwater system pumps,
- review of results of the surveillance testing of the auxiliary feedwater system turbine driven pump,
- review of results of the residual heat removal pumps surveillance testing,
- review of results of the essential service water pumps surveillance testing,
- review of results of the reactor protection system surveillance testing,
- calibration of instrumentation,
- activities in the field of testing of the motor operated valves,
- temporary storage of the old steam generators.

d) Emergency preparedness:
- inspection of the status of the document "Emergency plan",
- implementation of the Revision 21,
- training in emergency response planning,
- preparation of the NEK-2001 emergency drill,
- participation in the NEK-2001 emergency drill (as an observer - at the Krško NPP site) and appraisal of the drill,
- performance of the technical support centre, the operation support centre and the off-site emergency centre.

e) Physical protection:
- plant security performance,
- walkdown of the safety fence,
- planned and implemented modifications,
- check up of measures of the Krško NPP related to the terrorist attacks of 11 September 2001.

f) Engineering and training of personnel:
- review of planned modifications for the Outage 2001,
- review of planned modifications for 2001 to be implemented outside the Outage 2001,
- construction project of the plant main transformer station RTP 400/110 Krško with high voltage cables switchyard,
- correcting deficiencies of the full scope simulator of the Krško NPP,
- status of the Process Information System,
- performance of the Independent Safety Assessment Group (ISEG),
- feedback of operating experience (OEF),
- status of the Document Control Centre of the NPP Krško,
- preparation for the procurement of a new transformer GT3,
- insurance of liability for nuclear damage.

g) Quality assurance:
- review of the list (base) of work orders,
- status of external and internal audits,
- activities of the Quality Systems Division during an outage.

Besides inspections, the Nuclear Safety Inspection Division also took part in other activities :
- preparation of documents for sessions of the Nuclear Safety Expert Commission and participation in sessions,
- participation in auditing the operating staff regarding their qualification (Special Commission of experts, operations department management and instructors),
- active participation in more important project teams of the SNSA,
- active participation in sessions of the NSEC and in the performance of exams,
- participation in particular administrative issues,

- participation in orderly duties,
- active participation in meetings of the Nuclear Society of Slovenia,
- preparation of the new law on nuclear safety,
- participation in working groups for the preparation of some regulations,
- review of modification packages from the field of electric systems,
- additional training.

Below, a description of single activities of the Krško NPP in 2001 and findings of the SNSA inspectors are given:

1. Inspection of arrival of fresh nuclear fuel:

Fresh nuclear fuel, designed for the refuelling 2001, arrived into the Port of Koper on 19 April 2001 at 19:15. The fuel was in packages by two elements in 18 containers (USA/9239/AF Type A – marked as II Yellow), by two containers in a standard open container (20 feet – 20') – together 36 fuel assemblies. Total Transport Index on a semi trailer did not exceed 50 . Loaded trucks were placarded RADIOACTIVE III and UN Class 7 for fissile material. All vehicles (5 trucks) had valid certificates for the transport of dangerous goods. Vehicles were equipped by yellow rotating lights and the required equipment, which was checked by the Ministry of the Interior. There were no peculiarities. After the unloading was finished the transport departed for the Krško NPP and reached it without any troubles.

2. Reports on unusual events - reported by the Krško NPP

In 2001, the Krško NPP in conformity with the Rules on Reporting (Off. Gaz. SRS, No. 12/81) sent to the SNSA one report on an unusual event: high temperature in the area of the main steam lines (4 August 2001). The unusual event was due to very high daily temperatures and had no consequence on nuclear safety, which was confirmed by an analysis.

3. Outage and Refuelling 2001 at the Krško NPP (end of the 17th fuel cycle) – reported by the SNSA

Outage 2001 at the Krško NPP started on 9 May 2001 by power reduction to zero power parameters. The main objective of the outage was the refuelling, regular maintenance and in-service inspection, inspection of a reactor vessel and parts of the primary system loops and modifications, ensuring safe, reliable and stable operation of the power plant during the next cycle.

The outage took 42 days and was completed on 18 June 2001.

During the 2001 outage, the SNSA reintroduced a 24 hours presence of an inspector, who followed the outage activities and co-ordinated work among the Krško NPP, technical support organisations and the SNSA, as well as the SNSA itself, which proved to be good practice during the last outage. The presence of an inspector improved the exchange of information and enabled that the problems are solved faster. By 19 June 2001, the inspectors prepared 42 daily reports on the outage activities. The reports were presented on the SNSA Intranet for internal use.

During the Krško NPP outage there were also 6 regular inspections performed by the SNSA inspectors.

The technical support organisations reinforced the Inspection in the Outage 2001 inspection activities. In the Outage 2001 eight technical support organisations were involved (EIMV, Ekonerg, IE, JSI, IMK, FME, IMT, WI), co-ordinated by the EIMV.

During the 2001 Outage regular weekly meetings with representatives of all technical support organisations took place, where the organisations reported in writing and verbally on the outage works they supervised, on their findings and recommendations, and presented the working plan for the following week. Besides weekly meetings, discussions on current problems with representatives of the individual authorised technical support organisations were held.

The major outage activities inspected were the following:
- shutdown of the plant, safety at shutdown, availability of the safety functions,
- inspection/refuelling,
- visual and radiographic review of reactor coolant pump casing no.2,
- post maintenance and surveillance testing of safety equipment,
- maintenance of the electric, mechanical and I&C equipment,
- in-service inspection programme,
- overhaul of the emergency diesel generators,
- modifications of the safety systems:
- replacement of control rods split pins
- replacement of regenerative heat exchanger
- replacement of the main transformer,
- maintenance works in the switchyard,
- test of the emergency external 110 kV power supply from the standby thermal PP Brestanica,
- collective dose (planned vs. actual),
- review of the radiological data,
- start-up and synchronisation of the plant to the grid.

Problems encountered:
- overflow of oil of the reactor pump no. 2,
- increased contamination in the reactor building,
- problems at the replacement of a motor turbo charger on the diesel generator no. 2,
- core exit thermo-couple harm,
- breakdown of the computer for entry into the controlled area,
- foreign objects found at the visual inspection of the reactor pressure vessel,
- some activities at the replacement of the regenerative steam generator blowdown system (CSAHRG) were not registered in the quality plan,
- problems at sealing of the main electric generator and hydrogen filling,
- too high partial electric discharges of the electric generator,
- various interpretations of the Krško NPP-TSs regarding the testing of battery charger Train A,
- presence of sludge plug in starting instrumentation line for diesel generator,
- problems with the voltage regulator on the diesel generator no. 2,
- planned collective dose of the outage (1,740 manSv) was exceeded, which led to additional shielding and shifting of workers,
- breakdown of the lift for cleaning of reactor head screws,
- problems with the main feed water pump (FW105PMP-002) and condensate pump (CY100 PMP-003).

All problems encountered were properly solved and had no influence on nuclear safety.

Radiological protection:
At the beginning of the annual outage the Krško Radiation Protection Unit (after venting the containment, when an in-service inspection is performed to determine the status and to eliminate irregularities) performs dose rate measurements and checks the containment of work places surfaces. The measurements are performed in accordance with the procedure PRZ-7.300 »Radiation and radioactive contamination control at the Krško NPP«. During the outage 2001, regular daily measurements were performed as well as measurements of each individual

activity for which higher dose rates were probable. The staff at work places was adequately informed of the measurements performed (working conditions). The Krško NPP maintained the data base of received doses, which was periodically reviewed.

Dosimetry:
Systematic radiological monitoring of the Krško NPP staff and external contractors is defined in the internal procedure ADP – 1.7.006 "Personal dosimetry", Rev. 2, valid from 20 October 1998. As stated by the Krško NPP (Regular inspection of 14 September 1999) the procedure is in agreement with EU Directives No's 90/641 and 96/29. According to the Krško NPP statement method and content of keeping records of received doses by the workers satisfy EU standards. General prerequisites for issuance of permit for entering and working in the controlled area (in accordance with the internal procedure ADP - 1.7.008) are valid exam from radiation protection and medical certificate. The ALARA analysis of the work done was carried out in order to find out the reasons for the deviation of the doses received from the planned ones. These data are intended for future planning of ALARA and other jobs.

Received doses to the workers during the outage:
The collective dose to the workers during the annual outage was 1003 man mSv and exceeded the planned value 900 man mSv. According to the original ALARA plan, doses to the workers due to the clean-up of the motor oil overflow (41 man mSv) and the replacement of a thermo couple (5 man mSv) were not planned. It was found out that the received doses planned prior the annual outage were actual, if the received doses are taken from the collective rate. The received dose to the workers for the pump works was 60 man mSv and for the regenerative heat exchanger works 95 man mSv. Comparing the foreseen and received doses it is evident that the planned doses were exceeded at the following activities: replacement of the regenerative heat exchanger (planned rate 71,3 man mSv, received rate 95 man mSv) and LTOP modification (planned rate 11,8 man mSv, received rate 32,5 man mSv). The highest daily rate (3,72 mSv) was received by an outside worker at a nozzle dam insertion in the stem generators. The highest doses were received by outside workers during the eddy current inspection of steam generator tubes.

The inspectors determine that the 2001 annual outage was much more demanding from the previous one regarding the planning as well as the time available, equipment and man power engaged for individual activities.

All troubles observed above were solved prior the start up of the plant.

Good practice:
- primary coolant chemistry improvements at shutdown (insignificant release of Cobalt)
- access of inspectors and representatives of technical support organisations to internal computer network Intra NEK.

On the basis of the prior issued statements the »Joint Statement for Re-establishment of the Krško NPP Criticality after the Outage 2001«, the »Joint Statement for Full Power Operation of the Krško NPP after the Outage 2001, the EIMV issued also the »Joint Expert Assessment on the Outage 2001 and Refuelling in the Krško NPP« dated 27 July 2001.

In October and November 2001, the Nuclear Safety Inspection Division carried out inspections with representatives of all technical support organisations and the Krško NPP on the »Joint Expert Assessment on the Outage 2001 and Refuelling in the Krško NPP«, with particular attention given to the recommendations and elimination of the non-conformances.

The Inspection will take care of the implementation of the recommendations mentioned above. It is a conclusion of the Inspection that the outage performance has been improved from the organisational as well as the quality aspect, which is confirmed also by the operational indicators. The Inspection also assesses that the performance of the technical support organisations during the outage has improved over the last few years. There was no significant criticism regarding the mutual co-operation during the outage, neither from the technical support organisations nor from the Krško NPP.

The general conclusion on the outage was that all the works were done correctly and were assessed by the technical support organisations within their scope of authorisation. The technical support organisations satisfied the requirements from the contract between the EIMV and the Krško NPP on the elaboration of the Joint Expert Report on the Assessment of Works, Interventions and Tests during the Outage 2001 and Refuelling in the Krško NPP, consisting of the expert assessments of individual technical support organisations.

2.2 RESEARCH REACTOR TRIGA MARK II IN BRINJE

2.2.1 OPERATIONAL SAFETY

2.2.1.1 Operation

The purpose of the reactor is to carry out experimental work, to train the Krško NPP personnel and to prepare radioactive isotopes for medicine, industry and nuclear chemistry. In 2001, the reactor TRIGA Mark II operated 165 days and produced 279 MWh of thermal energy. Altogether 704 samples were irradiated in the F-channels. 1500 samples were irradiated in the pneumatic transfer system. The reactor worked only once in the pulse mode in 2001, and 15 pulses were performed. Also core changes (fuel removing) were made for experimental purpose. There were no events in 2001 with effect on nuclear safety. There were no damages on reactor devices in 2001.

2.2.1.2 Reactor shutdowns

210 shutdowns of the reactor were carried out in 2001 and 13 of these were unplanned. The reason for the unplanned shutdowns was loss of off-site electrical power (5 events), and operator mistake (8 events).

2.2.1.3 Fuel

Altogether 94 fuel elements were kept in the reactor building of RIC on 31 December 2001. They were situated on the locations given in Table 2.19:

Table 2.19:Locations of fuel elements at TRIGA MARK II.

Location	No. of fuel elements
reactor core	56
reactor tank	0
irradiate fuel store	0
fresh fuel store	38
Total	94

2.2.1.4 Personnel

The personnel was the same as in previous years and did not change in 2001 (the head of the reactor centre (1/3 of full time job)) and two main operators, two operators (full time job) and a secretary (1/2 of full time job). The operating scheme was organised in accordance with the organisational scheme, which is described in the Safety Report of the reactor.

2.2.1.5 Maintenance and purchase of equipment

In 2001 a new pneumatic transfer system was installed. It was donated by the IAEA in the scope of technical support to Slovenia. The cost of this device was 250,000 USD. The installation of the device was done by the personnel of RIC. It will start with operation in spring 2002.

2.2.2 RADIOACTIVE WASTE

In 2001, 50 L of LILW was produced during the operation of TRIGA MARK II research reactor. This radioactive waste is stored in the premises of the Reactor Infrastructure Centre, because public service on radioactive waste management does not work regularly but only in cases of interventions due to a delay on the project of refurbishment of the Central Interim Storage for Radioactive Waste at Brinje.

2.2.3 MONITORING RESULTS

In the reactor operation and other related activities in 2001 no special events occurred, and the total produced thermal power was comparable to the previous year. Releases of ^{41}Ar into the air (approx. 1 TBq in 2001) were directly correlated to reactor operation and were also similar. Measurements of radioactivity on the ventilation shaft with TL dosimeters showed an increase by a factor 2 compared to the background due to Ar-41.

Radionuclides Na-24, Co-60 and Zn-65 were detected in the liquid effluents during the year 2001. The total released activity was 0.51 MBq, resulting from the research work at the Department of Environmental Chemistry. The activity of liquid effluents was 2 times lower than the year before.

2.2.4 PERSONNEL EXPOSURE TO RADIATION

The personnel involved in reactor operation, who also operated the Central Interim Storage for LILW in Brinje up to 1999, can be divided in 3 categories:
Reactor operators
- Researchers and personnel handling radioactive specimens
- Radiation protection personnel (who received the dose also during handling sources not connected to the reactor TRIGA MARK II operation).

The radiation protection personnel could also receive doses from sources not connected to the work of the TRIGA MARK II reactor. Altogether 43 persons received an additional dose, the average in the year 2001 was 0.05 mSv (not taking into account the neutron dose), the collective dose was 1.96 manSv.

2.2.5 INSPECTIONS

On 30 August 2001 an inspection of the Reactor Centre Podgorica was performed, where the implementation of a SNSA decision of 10 November 2000 was discussed (decision NO. 391-01/00-5-26546/MK on radiological monitoring).

The SNSA’s requests were the following: to ensure continuous air sampling (purchase of equipment is under way), to prepare an annual meteorological report (the JSI suggests the SNSA to re-examine the request) and to review the procedures for radioactive control (the revision is in progress).

The findings of the inspection were the following:
- survey of gamma radiation monitor, aerosol sampling system, meteorological system,
- review of the Annual summary report on results of measurements of emissions and radioactivity in the living environment for 2000.

On 17 December 2001, the second inspection was held dealing with:
- the project of the installation of a fast pneumatic transfer system for short lived radioisotopes proceeds according to the plan,
- the status of the emergency plan,
- planned activities regarding the rector operation in 2002,
- foreseen major maintenance works in 2002.

2.3 CENTRAL INTERIM STORAGE FOR RADIOACTIVE WASTE AT BRINJE

Since September 1999, Agency for Radwaste Management has been the operator of the storage. The operating of the storage is a part of public service related to radioactive waste management.

2.3.1 REFURBISHMENT OF THE STORAGE

In early 2001, the Agency for Radwaste Management put up an auxiliary building close to the storage, intended mainly for storing various equipment and tools, because the storage itself did not provide enough space for these activities.

In September 2001, the SNSA issued a decision to the Agency for Radwaste Management, requiring, among other things, to carry out the project of refurbishment and to prepare a Final safety report on storage in accordance with the refurbishment project. Additionally, the Agency for Radwaste Management was required to accept the radioactive waste produced on the territory of Slovenia in medicine, research and industry which represents danger to the public, workers and the environment, if such was the decision of the responsible body.

The Agency for Radwaste Management failed to fulfil the demands of the SNSA partial decision both by the initial as well as the extended deadline (end of July 2001). In February and April 2001, the Agency for Radwaste Management was informed by the SNSA that it would not be allowed to carry out the refurbishment without appropriate technical documentation for construction under nuclear legislation, and that the activities should be based on the partial decision and the request to modify the application. Also the Administration Unit in Ljubljana (Bežigrad) and the Ministry for Environment and Spatial Planning (Service for the Construction of Facilities of National Importance) were informed about the planned refurbishment activities. Inspite of that, the Administration Unit in Ljubljana – Bežigrad, issued a decision which was allowed the Agency for Radwaste Management to start with replacement of hydro-insulation on the nuclear facility. By this decision, the SNSA, as a regulatory body, was simply by-passed in the administrative procedure.

Apart from the fact that the refurbishment conditions of the SNSA as the regulatory body for nuclear facilities were not fulfilled, the Agency for Radwaste Management started with the replacement of hydro-insulation, based on the decision mentioned above. The SNSA was informed about this fact by a letter dated 12 November 2001.

An inspector for nuclear and radiation safety from the SNSA issued, in accordance with official obligation, decision No. 39313-2/2001/7/IN/135, dated 14 November 2001, forbidding all activities on the storage facilities without prior approval of the SNSA. Despite this demand and a clause in the decision stating that a complaint cannot stop the fulfilment of the demand, the Agency for Radwaste Management continued with the refurbishment and subsequently filed a complaint on 29 November 2001. In the course of considering the complaint, the SNSA took into account the public interest of fast finalisation of the refurbishment and it partially complied with the requests of the client. It also took into account the fact that the work was being performed during inappropriate early winter time. The works had already reached a stage at which it was impossible to restore the original state of the facility without a complete replacement of hydro-insulation. With a new decision, No. 39313-2/2001/50/IN/135, dated 24 December 2001, the SNSA cancelled the first decision but reiterated the demands of the partial decision which had not been fulfilled by that time. The works on hydro-insulation replacement were finished on 12 December 2001. The client in the procedure made a complaint also against the second decision. The Agency for Radwaste Management did not submit the necessary documents for the refurbishment of the storage in 2001, demanded by the decision from 1999, although two years had passed since then. The SNSA therefore could not confirm the Final safety report and the execution of the related works.

2.3.2 RADIOACTIVE WASTE

In 2001, 7 sealed sources were accepted in the storage. These sources were disused and their owners had been the Clinic for Dermatology, Motel Grosuplje and the Žirovski vrh (former uranium) Mine. Another source (a lightning rod) had been found in scrap before this was exported to Italy. It was also accepted in the storage. Table 2.20 below shows the inventory of radioactive waste accepted in the year 2001 and Table 2.21 shows the total inventory of the storage.

Within the scope of IAEA’s technical support, the Agency for Radwaste Management carried out, between 18 and 21 June 2001, the conditioning of the radium sources located in the storage as well as the sources located and owned by the companies mentioned above. The conditioning was carried out by an expert group from the Austrian Research Center Seibersdorf, in the hot laboratory of JSI.

Table 2.20: Radioactive waste stored in the year 2001.

Type of radioactive waste	Number	Isotope	Activity [GBq]
Disused sealed source of ionising radiation (lightning rod)	2	Eu-152	14
Sealed source for application in medicine and industry	5	Ra-226	0.32
Total	7	Eu-152, Ra-226	14.32

Table 2.21: State in the Central Interim Storage for Radioactive Waste at Brinje at the end of 2001.

Type of waste	State in the storage	Main isotopes	Total assessed activity at the end of 2001 [GBq]
Drums	254	Co-60, Cs-137, Ra-226, Eu-152, natural uranium	from 30 to 47
Special waste	140	Co-60	2382.8
Sealed sources	346	Co-60, Cs-137, Kr-85, Sr-90, Eu-152	574
Undetermined sources *	34	-	-

Total	774	Co-60, Cs-137, Ra-226, Sr-90, Kr-85, Eu-152, natural uranium	app. 3000

*Undetermined sources, which are without adequate labels and are not included in the records of the previous storage operator.

2.3.3 RADIOACTIVE RELEASES INTO THE ENVIRONMENT

Rn-222 and its progeny emissions from the LILW storage facility were estimated based on a release model. It showed the released activity to be 70 Bq/s, almost independent of storage ventilation, which amounts to a yearly release of 2.2 GBq. Measurements with TL dosimeters indicate that at a distance of 10 to 20 meters from the storage facility the radioactivity level falls down to the level of natural radioactivity in the background environment.

2.3.4 PERSONNEL EXPOSURE

LIL waste storage has been operated by ARAO since 1999, when ARAO also introduced regular monthly dosimetry, performed by the authorised organisation IOS. Table 2.22 shows the received doses until the year 2001, as well as the collective dose. The doses of the contractors hired for the preparation of radium sources for storage and hydro-insulation refurbishment works are not shown. The first group of contractors (3) received a collective dose of 0.87 man mSv, the latter (19 workers) 0.06 man mSv.

Table 2.22: Collective and average effective dose for ARAO personnel for the year 2001.

Year	Collective effective dose [man mSv]*	Number of workers	Average dose [mSv/year]*
1999	0.92	5	0.18
2000	2.21	5	0.44
2001	2.74	6	0.46

* Monthly doses bellow 0.04 mSv were not reported; on a yearly basis they amount to 0.48 mSv per worker.

2.3.5 INSPECTIONS AT THE ARAO AND THE CENTRAL INTERIM STORAGE FOR RADIOACTIVE WASTE AT BRINJE

In 2001 there were 29 inspections performed at the ARAO and the Central Interim Storage for Radioactive Waste at Brinje.

A regular inspection of the Central Interim Storage for Radioactive Waste at Brinje was performed on 1 April 2001 in order to check the status of the storage and the environment, to verify the documentation and the implementation of the partial decision of the SNSA No. 392-04/99-1-22907.io of 14 September 1999 (Administrative issue - Refurbishment of the Central Interim Storage for Radioactive Waste at Brinje). There were no additional requests by the inspectors.

A regular inspection of the ARAO was performed on 26 October 2001 in order to verify the implementation of the Decree on the mode, subject and conditions of practising the public service of radwaste management (Off. Gazette of RS, No. 32/99) and the status of modernisation of the Central Interim Storage for Radioactive Waste at Brinje. There were no additional requests by inspectors.

On 8 November 2001, a discussion among representatives of the JSI, ARAO and SNSA was held on the issue of the planned start up of construction works in connection with the administrative issue Refurbishment of the Central Interim Storage for Radioactive Waste at

Brinje. The ARAO was informed that according to the SNSA decision No. 392-04/99-1-22907.io of 14 September 1999 (administrative issue – Refurbishment of the Central Interim Storage for Radioactive Waste at Brinje) the requirement was not fulfilled and that the planned works should not be started – the replacement of isolation. In case the works were started, the inspection should take appropriate steps.

On 12 November 2001, the SNSA inspection found out that remedial actions on outside isolation began. The inspection issued an oral decision forbidding the works at the Central Interim Storage for Radioactive Waste at Brinje, for which a previous licence was not issued. With reference to this decision, a proposal to a judge for violations was made.

On 14 November 2001 the SNSA inspection cancelled in writing the oral decision forbidding the works at the Central Interim Storage for Radioactive Waste at Brinje, for which a previous licence was not issued. The ARAO made a complaint (28 November 2001) and required the cancellation of the above-mentioned decision. On 24 December 2001, the SNSA complied with the demand and issued a decision cancelling the above mentioned oral decision and its copy. That decision forbade the performance of all further works regarding the modernisation of the Central Interim Storage for Radioactive Waste at Brinje, except the replacement of outside isolation which was already made. The ARAO also made a complaint to that decision.

Referring to the administrative issue "Dosimetric control of workers exposed to ionising radiation during the replacement of outside isolation at the Central Interim Storage for Radioactive Waste at Brinje" the SNSA issued a decision on 28 November 2001. In this connection a complaints procedure has been started.

The remaining inspections, altogether 27, dealt with the implementation of the decisions issued by the SNSA and the status of construction (during the replacement of isolation). The minutes and official notes were prepared and photographs (classical and digital ones) were taken.

2.4 URANIUM MINE ŽIROVSKI VRH (RŽV)

2.4.1 ACTIVITIES FOR PERMANENT CESSATION OF EXPLOITATION OF THE URANIUM ORE

RŽV performed a revised programme on "Permanent cessation of exploitation of uranium ore and preventing the consequences of mine exploitation at Žirovski vrh" in the year 2001. The basis for this programme were two annexes of the "Operational plan of activities" for performing the programme in the year 2001, which was approved in May and September 2001 by the Government of the Republic of Slovenia. Thus it was only at the end of the year 2001 that RŽV was granted the formal basis for performing the programme. This delay is of course not in line with the necessity to ensure the right conditions for safe and economical work on the programme.

In 2001, the activities which were performed had been designed to actively prepare the mine for a permanent cessation of exploitation of uranium ore in the following period, then for permanent disposing of the removed ore, disposing of closed mine carriages with uranium ore, and also disposing of the archive of geological samples. Also the final technical review of the performed works on permanent cessation of production of uranium concentrates was carried out. In addition all the planned work and activities aimed at obtaining a loan at the European Investment Bank were performed, as well as evaluation of adequate technical solutions for the cessation of exploitation, and evaluation of their compliance with domestic and European legislation. The evaluation was performed by the German enterprise Wismut GmbH. In accordance with the Law on permanent cessation of exploitation of uranium ore and preventing the consequences of mine exploitation at Žirovski vrh (Off. Gaz. RS, No. 28/2000;

ZTPIU-A), the necessary activities were carried out in order to transform RŽV to a firm with limited liabilities.

The activities carried out at different facilities are described below:

a) Facility for the production of uranium:
- Review and refurbishment of the mine rooms which are needed for performing activities in the mine in the year 2001, including works on power installations and technical water,
- Removal of the uranium ore from the area above the crusher plant through the radiometric door to the mine site (contents U_3O_8 > 250 g/t) or to the Jazbec mine waste disposal site (contents U_3O_8 ≤ 250 g/t),
- Preparation of the former refectory in the mine for permanent disposing of geological samples and ROV-type containers which contain radioactive waste from RŽV. Most of this waste was from the area of primary crusher. It was decided not to decontaminate the waste but to dispose it and fill it by a throw dike,
- Cutting, decontamination and measuring of the contamination of useless and ageing mine equipment,
- Making of drainage bore-holes for refurbishment of the drainage system under the Jazbec mine waste disposal site (performer: RGD d.d.)
- Regular maintenance of the roads and draining of meteoritic water in the area of the Jazbec mine waste disposal site and the disposal site at P-1 and P-9,
- Regular control and maintenance of the mine entrances.

b) Facility for the production of the uranium concentrate:
- Dismantling of the equipment and removal of the catching pit with a channel at building No. 313, transport of material to the Jazbec mine waste disposal site and filling of the pit with inert material (performer: TOPOS d.d., RŽV d.o.o.)
- Regular maintenance of the mill tailings Boršt site and its channels of meteoritic and sipping water,
- Acquisition of a permit for the use of buildings of the facility for the production of the uranium concentrate.

c) Facility for electric-mechanical maintenance:
- Carrying out regular examination, testing and maintenance of the electric-mechanical equipment and installations in the mine and outside,
- Completed refurbishment of the air station P-36, preparation and start-up of the ventilating fans,
- Regular assurance of operation of the air station P-1 in P-36,
- Examination and refurbishment of the transformer distribution stations RTP 530 and RTP H-33 and assurance of electric power in the mine,
- Examination and general repair of the mine equipment needed for assuring safe conditions in the mine.

d) Sector of safety activities:
- Regular inspection of the working area,
- Regular inspection of the influence of the mine on the environment,
- In the frame of decommissioning and decontamination, measurements of radioactivity were performed in the buildings, on the macadam area of the facility for the production of uranium concentrate and on the site P-10.

2.4.2 RADIOACTIVE WASTE

According to RŽV data, 11,666 tonnes of ore with average contents of 421 g/t U_3O_8 was disposed at two special locations in the mine. Of this, 10,517 tonnes of waste was disposed at tunnel S-7/5 and 1,149 tonnes at tunnel S-(4-5)/1. At the Jazbec mine waste disposal site, a total of 5,500 tonnes of poor ore with average contents of 191 g/t U_3O_8 was disposed. This represents 5,955 kg of U_3O_8.

In the year 2001, a permanent disposal of closed mine carriages with uranium ore was performed, as well as that of the archive of geological samples and ROV-type containers (with a volume of 2 m^3) with contaminated material from dismantling of the crusher (metal, plastics) and useless slashed mine equipment, all this was disposed into the former refectory of the mine. In total, there were 13 ROV-type containers with a total mass of 20 tonnes, 15 barrels with geological samples of uranium ore (with a total mass of 8 tonnes), 4 carriages with a total mass of 6 tonnes and 10 tonnes of contaminated electric cables, pneumatics and plastics. Together 44 tonnes was disposed.

In the year 2001, 6,000 tonnes of contaminated material (poor ore, soil, ruins) from the facility for the production of uranium concentrate and the facility for the production of uranium ore was disposed at the Jazbec mine waste disposal site.

During the demolition of the catching cave of the facility for the production of uranium concentrate, 561 tonnes was transported through a radiometric door RV-3 (concrete and contaminated macadam) to the Jazbec mine waste disposal site.

2.4.3 POSITION OF THE SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

1. Revision of the Programme on "Permanent cessation of exploitation of uranium ore and preventing the consequences of mine exploitation at Žirovski vrh".

RŽV states in its "Annual report (for the year 2001) on safety activities against ionising radiation and the impact of the uranium mine Žirovski vrh on the environment", that the planned work and activities aiming to obtain a loan from the European Investment Bank were performed, as well as evaluation of adequate technical solutions of cessation of exploitation and evaluation of their compliance with Slovenian and European legislation. Experts from the German company Wismut GmbH carried out the evaluation.

Following an initiative of the European Investment Bank (EIB), the company Wismut GmbH made a revision of the Programme on "Permanent cessation of exploitation of uranium ore and preventing the consequences of mine exploitation at Žirovski vrh". The purpose of the revision was to give EIB and MOP assurance that the programmes of remediation of RŽV were suitable.

The revision was focused on:

- assessment of the liabilities, technical solutions, efficiency and effectiveness, optimisation and cost saving potential,
- examination of compliance of the measures with the national and international legal requirements, consistency and transparency of costs and comparison of costs with international remediation projects,
- recommendation for improvement of the technical deficiencies, scheduling of the remediation and documents for the submission of an investment proposal.

In connection with closing of the tailings pile, the SNSA quotes the following opinions and recommendations of Wismut GmbH:

- a long-term stable status of the remediation facilities and landscape adjustment,
- construction of the proposed multi-layer cover is complicated, particularly on the steep slopes of the pile. The possibility of intensive rainfalls has to be considered in the selection of the technology of cover construction. The cover technology should be practically tested in field tests. The erosion resistance of the cover against the rainfall (projected maximum in 1000 years) is not shown in the documents.

- It has been taken into account that the drainage and surface waters should be discharged by the shortest way from the waste pile. The water balance of the pile should be set up to make it possible to evaluate the effectiveness of the possible remedial measures.
- Long-term stability of the tailings pile Boršt remains vulnerable to sudden disruptive events such as new landslides and earthquakes. Because Žirovski Vrh is in a tectonically active area, occurrence of earthquakes of considerable magnitude is very likely. The influence of earthquakes on the stability of the tailings pile Boršt was calculated with geo-technical models (FLAC) using acceleration diagrams for 4 earthquake scenarios. The results are presented in a study of the Slovenian National Building and Civil Engineering Institute Ljubljana (SNBCEI). The study (Study on Stability of the Landslide under Earthquake in the Area of the Tailings Boršt) concludes that permanent active supervision of the tailings pile is required.
- From the viewpoint of stability analysis of SNBCEI, the reviewer can not consider the tailings pile Boršt as stable in terms of a long-term perspective. The question has to be answered how to handle the persisting landslide risk. The decision on how to proceed with the remediation should be based on the evaluation of the consequences of the failure versus the costs of its stabilisation. The decision-making on long-term stabilisation of the landslide has to involve all key stakeholders.
- Before proceeding with plans on improvement of the effectiveness of the drainage tunnel it is recommended to evaluate all landslide stabilisation options for the most effective (and cost-efficient) strategy. Without a clear remedial strategy on the landslide, an isolated action may end up to be just an expensive step, only marginally increasing the long-term stability of the site.

The opinions and recommendations of Wismut GmbH are in accordance with the opinion of the SNSA that long-term stability of the tailings pile Boršt remains vulnerable to sudden disruptive events such as new landslides and earthquakes.

2. Location permit

On 4 July 2002, the Attorney general's office of the Republic of Slovenia informed the SNSA of the decision of the Administrative court of the Republic of Slovenia to comply with the complaint of the SNSA. The decision of the MOP, No. 350-03-77/95-SR/VM, from 10 January 2000, was abolished. The matter was returned to the MOP for a new procedure. The above-mentioned decision of MOP was issued in spite of the fact that the SNSA had issued a negative conformity on the local permit for the final remediation of exploitation area of the Žirovski vrh Mine No. 370-01/99-1-23469/LV, from 30 November 1999. In the above-mentioned procedure, the MOP presented the negative conformity on the local permit for the final remediation of exploitation area of the Žirovski vrh Mine as a non-binding expert opinion.

Sources

- Annual report on performing of safety activities against ionising radiation and impact of the uranium mine Žirovski vrh on the environment for the year 2001, Žirovski vrh Mine
- Ocena tehničnih in ekonomskih ukrepov v zvezi z zapiranjem Rudnika urana Žirovski vrh, Slovenija, junij 2001, Wismut GmbH

2.4.4 RADIOACTIVE RELEASES INTO THE ENVIRONMENT

1. Impact on the living environment

The monitoring of the impact of the Žirovski vrh Mine and both waste sites on the environment was performed in the same scope since 1992 according to the programme for emission and immission monitoring and the programme for radioactivity monitoring in the vicinity of the Žirovski vrh Mine, approved by the Radiation protection commission of the Ministry of Health of the Republic of Slovenia.

The radiation exposure pathways were the same as in previous years:

a. Water path: mine water exhausts, meteoric waters from the tailings piles,
b. Air path: radon from both tailings piles surfaces, temporary ore and tailings deposits on the P-10 plateau, forced and natural ventilation from the mine pits,
c. External radiation near the tailings piles and temporary ore and tailings deposits on the P-1 and P-9 plateaus.

The monitoring of environmental impact was based on:

a) A program of monitoring of liquid and gaseous effluents from RŽV (monitoring of emissions),
b) A program of radioactivity monitoring in the environment.

The monitoring of effluents was performed by the Radiological Protection Unit (sampling, protocols of measurements, radon concentration and PAE of radon short lived radon daughters, data control), analyses of liquid emissions by the RŽV and JSI laboratories (Ra-226) and radioactivity monitoring in the environment by the JSI together with the IOS.

2. Precipitation

The Hydrometeorological unit situated a few kilometres in the soutwest direction from Todraž measured 1468 mm precipitation in the year 2001, 300 mm less than the average from 1980 to 2000 (1770mm). Together 142 days were recorded with precipitation 0.1 mm or more, 20 days in January and March and only 6 days in October. The main contribution of precipitation in 2001 was recorded in September (290 mm) and the lowest value was detected in August (24 mm). Daily precipitation reached maximum in September (72mm), but much less than maximum values of precipitation in the previous years. Short and heavy rain which could possibly cause the damage on the external mine objects, especially on the Jazbec mine tailings and hydrometallurgic tailings at Boršt, were not recorded.

Snow cover was not recorded in the year 2001, and sharp frost with freeze of earth did not appear. Due to the long term of dry spell in the warmer period of the year the Brbovščica creek was dry from the spring of the Mrzlek creek to the measurement unit in Gorenja Dobrava (together 200 m of riverbed) from the end of August till the beginning of September. Such an event happened already for the third time in the last decade.

3. Liquid emissions

The schedule of the monitoring of liquid effluents in the releases from the Žirovski vrh Mine involved measurements of uranium and Ra-226 in all liquid release samples from the Žirovski vrh Mine, including meteoric waters from the mine pits and all the releases which contributed to contamination of surface waters. There are 20 measuring and sampling points for liquid emissions. The programme for liquid emissions includes monthly samples collected on all sampling points including meteoric waters from asphalt surfaces and roofs (usually on the first Wednesday each month), while the monthly composite of daily samples was collected for the points that contribute to the contamination of waterways. Also the Todraščica creek sample before the point where the Todražica creek flows into the Brebovščica creek was taken. The results of the monitoring of liquid effluents from the Žirovski vrh Mine and water courses are shown in Table 2.23. In monthly samples U_3O_8 was measured, in monthly composites U_3O_8 (RŽV) and Ra-226 (JSI). Samples were taken on working days and in the case of holidays if the work cessation exceeded 2 days. The total annual emission of U_3O_8 and Ra-226 activity in 2001 from the various mine facilities is given in Table 2.24.

Table 2.23: Monitoring of liquid effluents from the Žirovski vrh Mine and water courses in 2001.

Sampling site	Annual flow [1000 m^3]	Average conc. of dissolved U_3O_8 [mg/m^3]	Average conc. of dissolved Ra-226 [Bq/m^3]	Measurement December 2001 concentrations:	
				U_3O_8 [mg/m^3]	Ra-226 [Bq/m^3]
Monitoring of liquid releases					
Mine water treatment plant	718.4	249	47	265	70*
The Jazbec str. under the mine waste	242.4	391	42	307	31*
Joint drainage of the Boršt tailings pile	6.8	708	293	861	500
Overflow of the solids trap at Boršt	26.3	612	639		
Drainage of the solids trap at Boršt	1.8	569	222		
Drainage tunnel at the Boršt tail. pile	34.5	11	10		
Results of measurements in water courses					
The Boršt stream	269.7	3.3	20		

From monthly composite

Table 2.24: Cumulative annual emissions of U_3O_8 and Ra-226 in individual facilities of the Žirovski vrh Mine in 2001.

	Amount of U_3O_8 [kg]	Emission share [%]	Activity Ra-226 [MBq]	Activity share [%]
Mine	182	61	32	57
Jazbec mine waste	93	32	8	15
Boršt tailings pile	21	7	16	28
Total ŽVM 2000	296	100	56	100

After the increase of specific Ra-226 activity in the mine water for the year 2000 up to the annual average of 73 Bqm^{-3}, the trend reversed in the beginning of the year 2001, when it gradually fell to 47 Bqm^{-3}, which is less than the limit prescribed by the Ministry of Health (60 Bqm^{-3}). This occurred in spite of the increase in volume of liquid releases and the reason for this is unkown, for there were no activities that would cause this change. The total activity was lower than in the year 2000 and also lower than the limit prescribed by the HIRS (50 MBq).

The gradual decrease of U_3O_8 concentration in mine water in the previous years stopped and the total mass of U_3O_8 in liquid effluents in the year 2001 increased compared to the year 2000 because of the increase in the volume of liquid releases.

In the year 2001 there were no activities that would change the amount of U_3O_8 or Ra-226 released from the Mine to the environment

During working days, the water from the mine waste Jazbec, where the contaminated containers and scrap equipment were temporarily stored during the years 1999 and 2000 as well as the water in the channel, 150 m below the exhaus, were regularly sampled by the Radiological Protection Unit of the mine. The site is temporarily covered but not in a watertight manner. The release consists of meteoric and waste waters, flowing over the contaminated scrap material, collected in a concrete trap and conducted through piping in the channel by the P-10 to P-1 road. Daily samples were taken and measured for U_3O_8 concentration until October, and since then a 5 days' composite was measured, as well as water flow at the exhaust for each sampling. The total number of samples thus collected in the year 2001 was 153, with 122 analyses conducted. The highest U_3O_8 concentration measured at the exhaust was 1.504 microg/l with exhaust flow of 0.023 l/s, and the lowest 583 micro g/l with exhaust flow of 0.001 l/s. The average concentration of U_3O_8 in the samples was 926 micro g/l, with an average flow of 0.005 l/s. The amount of U_3O_8 thus released was 0.08 kg or 0.03% of the whole U_3O_8 amount released from the mine in the year 2001. The evaluation of mass releases is based on the measurements of flows and concentrations assuming the same values for 24 hours. The U_3O_8 concentration in the channel 150 m below the exhaust was less than 10 microg/l (the bottom level of detection with the method used) in all but 23 cases, due to the dilution with the water from the Jazbec creek. This dilution was not present before the year 1996, since the water from the Jazbec creek streamed through plastic pipes to the outlet under the mine waste.

4. Gaseous emissions

Mine ventilation stations and ventilation shafts as well as tailings piles surfaces (hydrometallurgic tailings at Boršt, mine waste at Jazbec) and temporary dumps (mine waste at P-1 and P-9) are the main sources of gaseous emissions of Rn-222 from the former Žirovski vrh Mine.

With regard to the impact of radon concentrations on the environment, the sources are divided into low and high altitude sources. The former are situated below the limit of average temperature inversion (at an altitude below 500 m) and include the P-10 and P-11 tunnels (when the mine is ventilated naturally) and the Jazbec mine waste.

a. Releases from the mine

To decrease the release of Rn-222 from the ventilation shaft mouths, air flow barriers were mounted on the P-1, P-10 and P-36 tunnels and partly on the P-9 tunnel. The direction of natural ventilation varied with the outside temperature. At temperatures lower than 6^0 C (9^0 C) the air in the mine rose, at higher temperatures it descended. The mine pit ventilation operated partly during only one shift and partly during all three shifts from the end of May. Measurements of Rn-222 concentration, Rn-222 short-lived progeny concentration (PAEC) and air flow were made once a month. Table 2.25 gives maximum and minimum values at each mine outlet and the Jazbec mine tailings pile by-pass. The concentration of short-lived progeny are always lower than the concentration of Rn-222, because the equilibrium can not be reached in open systems.

Table 2.25: Maximum and minimum Rn-222 and short-lived radon progeny (PAEC) concentrations in emissions (1WL = 3700 Bq/m^3).

Source/Concentration	Rn-222 concentration [Bq/m^3]		PAEC[WL]	
	Rn-222 [Bq/m^3]		PAEC [WL]	
	Min.	Max.	Min.	Max.
P-11 tunnel*	11.160		1.51	
P-10 tunnel	No air flow was measured			
P-9 tunnel	No air flow was measured			
Ventilation shaft 6/2	1.572	10.175	0.22	3.27
Ventilation shaft ZJ-8	No air flow was measured			
Ventilation shaft with P-12 tunnel	893		0.08	
Ventilation shaft with PV tunnel	16.744	25.559	1.42	2.97

* just one measurement available

b. Release from the Jazbec mine waste outlet

At the end of the year 1999, a flow barrier was mounted on the outlet under the Jazbec mine waste, used for water drainage. This barrier allows water drainage but bars air flow, thus eliminating a considerable source of Rn-222 during the warmer part of the year. Due to this fact no Rn-222 impact was present at the lower part of the Brebovščica valley.

c. Annual emissions of Rn-222 from mine facilities

Emissions from each particular source are estimated to have been approximately 9.4 TBq in the year 2001. Table 2.26 shows contributions from different mine facilities.

The radioactivity measurements showed that the cessation of uranium ore exploitation only partially reduced the impact of the Žirovski vrh Mine on the environment, although the mine was closed for a decade. Major changes are not to be expected until full remediation of all the present tailings piles has been completed.

Table 2.26: Annual emissions of Rn-222 from different mine facilities.

Source		Activity [TBq]
Low altitude sources * Total 2,04 TBq	Jazbec mine waste, plateau P-10	1.50
	Jazbec mine waste outlet	0.00
	P-10 tunnel, natural ventilation	0.00
	P-11 tunnel, natural ventilation	0.54
High altitude sources ** Total 7,34 TBq	Ventilation station P-1, natural ventilation	0.13
	Ventilation station P-1, forced ventilation	1.67
	Ventilation station P-36, natural ventilation	0.58
	Ventilation station P-36, forced ventilation	1.16
	P-9 tunnel, natural ventilation	0.60
	Ventilation shafts, natural ventilation	0.45
	Mine dump P-1	0.28
	Mine dump P-9	0.47
	Tailings pile Boršt (upper layer 80% covered)	2.00
Total for year 2001		9.38

* Low altitude sources – below the limit of average temperature inversion (altitude below 500 m)
** High altitude sources – above the limit of average temperature inversion (altitude above 500 m)

2.4.5 EXPOSURE OF WORKERS TO IONIZING RADIATION

Within the scope of decommissioning, the Radiological Protection Unit (RPU) of the Žirovski vrh Mine regularly monitored the working site for uranium ore extraction and for uranium concentrate production, and measured contamination of the waste material and the facility surfaces.

Exposure of workers to ionising radiation was assessed by the RPU, on the basis of the following measurements and assumptions:
- Measurements of potential alpha energy of radon progeny in the air
- Sampling of solid particles in the air at active workposts (U_3O_8 concentrations measurements were made at the RŽV laboratory)

- TLD dosimetry was performed quarterly for all workers exposed, the workers in the laboratory were replaced monthly
- Logging of exposure time for individual workers at different mine facilities.

The doses received due to exposure to ionising radiation at the workplace were calculated according to classical methods usually used in RŽV. The annual effective equivalent dose (AEED) and the annual effective dose (AED) for each worker were calculated separately for underground work (mine pit, drainage tunnel) and outside work (uranium concentrate production facility, P-11 plateau, Jazbec and Boršt tailings piles). PAE exposition was taken into account, as well as dust particles with long-lived uranium progeny inhalation and external radiation. For AEED, the transformation factor exposure/received dose of 1 WLM/10 mSv was used, the same factor for LED was 1 WLM/5 mSv.

The highest contribution to doses received comes from PAE of radon progeny. PAE exposition of all workers in the pit was 6.7 WLM, while on the tailings piles and in the uranium concentrate production facility it was 8.12 WLM. In this case, the natural background radiation contribution was not subtracted.

Annual exposure of workers was estimated based on radon progeny concentration measurements and TLD dosimetry readings, taking into account the actual time of exposure at different worksites. The calculation of the annual effective dose received by workers was made in accordance with the generally applicable methodology. Due to low concentrations of short lived radon progeny and low dose rates the values were as low as expected.

Readings from TLD-s were generally very low or even under the detectable level. The additional collective annual effective equivalent dose (AEED) for RŽV personnel due to radiation exposure was 149.2 man mSv (the annual effective doses (AED) was 75.4 man mSv) and the AEED for outside workers was 7.7 man mSv (AED 4.1 man mSv). The calculation was made for 57 workers of the Žirovski vrh Mine and 7 contractors. The values of annual effective doses were very low. The highest AEED for 2001 was 5.89 mSv (AED was 2.95 mSv), the average AEED was less than 2.5 mSv (AED less than 1.3 mSv). The exposure of workers in RŽV to ionising radiation is shown in Table 2.27.

Table 2.27: Exposure of workers of the Žirovski vrh Mine to ionising radiation.

Year	Number of workers	Average [mSv]	Maximum dose [mSv]	Collective dose [man Sv]
1989*	350	5.0	18.00	1.75
1996	55	0.9	2.64	0.05
1997	70	1.3	3.40	0.09
1998	65	1.5	2.97	0.10
1999	60	1.0	1.89	0.06
2000	61	< 1.0	1.95	0.05
2001	64	< 1.3	2.95	0.08

* in period of regular operation

2.4.6 INSPECTIONS AT THE ŽIROVSKI VRH MINE

In 2001, one inspection of the Žirovski vrh Mine was performed (21 November 2001) to review:
- the documentation on quantities of uranium and uranium dioxide, which were sold to various purchasers prior the closure of the mine,
- the status of the area of former ore processing plant.

The SNSA requested to receive the missing documentation (export licences) and a new calculation of quantities of uranium (fulfilled on 3 December 2001).

A representative of the Nuclear Safety Inspection Division co-operated with the Commission of the Ministry of the Environment, Spatial Planning and Energy for technical review of installations and facilities constructed according to the mining projects for remediation of outside structures belonging to the mine and processing facilities.

2.5 INSPECTION CONTROL

In 2001, the SNSA inspectors spent 248 inspector days, the details are shown in Table 2.28, giving also the data for 2000.

Table 2.28: Distribution of inspections in the years 2000 and 2001 regarding the object of inspection.

	2000	2001
Object	Inspections [inspection days]	Inspections [inspection days]
NEK	245	201
JSI	4	6
ARAO	5	38
RŽV	2	1
ZPNB*	3	2
Total	259	248

*Inspections performed in accordance with the Act on transport of dangerous goods

Details on single inspections are given in chapters 2.18, 2.2.5, 2.3.6 and 2.4.6. for individual nuclear installations or for inspections of installations connected with nuclear cycle. Details on the transport of dangerous goods are given in chapter 5.2.

3 RADIATION PROTECTION IN THE LIVING ENVIRONMENT

This chapter contains a summary of reports on radioactivity monitoring in the living environment in Slovenia in the year 2001. It first gives information on the Radiation Early Warning System in Slovenia, which enables immediate detection of increased radiation on the territory of Slovenia in case of nuclear accident; this is followed by summaries of reports from authorised organisations on global contamination and on the operational impact of nuclear installations in the country.

3.1 RADIATION EARLY WARNING SYSTEM

Radiation early warning system is an automatic measuring system for immediate detection of potential contamination in case of a nuclear or radiological accident in country or abroad.

3.1.1 EXTERNAL RADIATION MEASUREMENTS

There are 44 probes for dose rate measurement of external gamma radiation throughout Slovenia; real-time data retrieval is possible from all 44 probes. Since 1996, when the fully computer-supported Central Radiation Early Warning System of Slovenia (abbreviation CROSS) was established within the SNSA, the real-time measurement data from all the existing systems of this type in Slovenia have been collected at one site. These network systems are managed by the following organisations: the Krško NPP, the Environmental Protection Agency (Office for Hydrometeorolgy), the SNSA, the Milan Vidmar Elektroinstitut, thermal power plant (Trbovlje, Šoštanj, Brestanica).The communication and computer infrastructure required for data transfer, archiving, analysing and representation as well as for alerting has been provided. All data are transmitted on the Internet and are presented at the SNSA homepage. The data are graphically presented in the form of a map of Slovenia (Figure 3.1) and also in the form of Table 3.1.

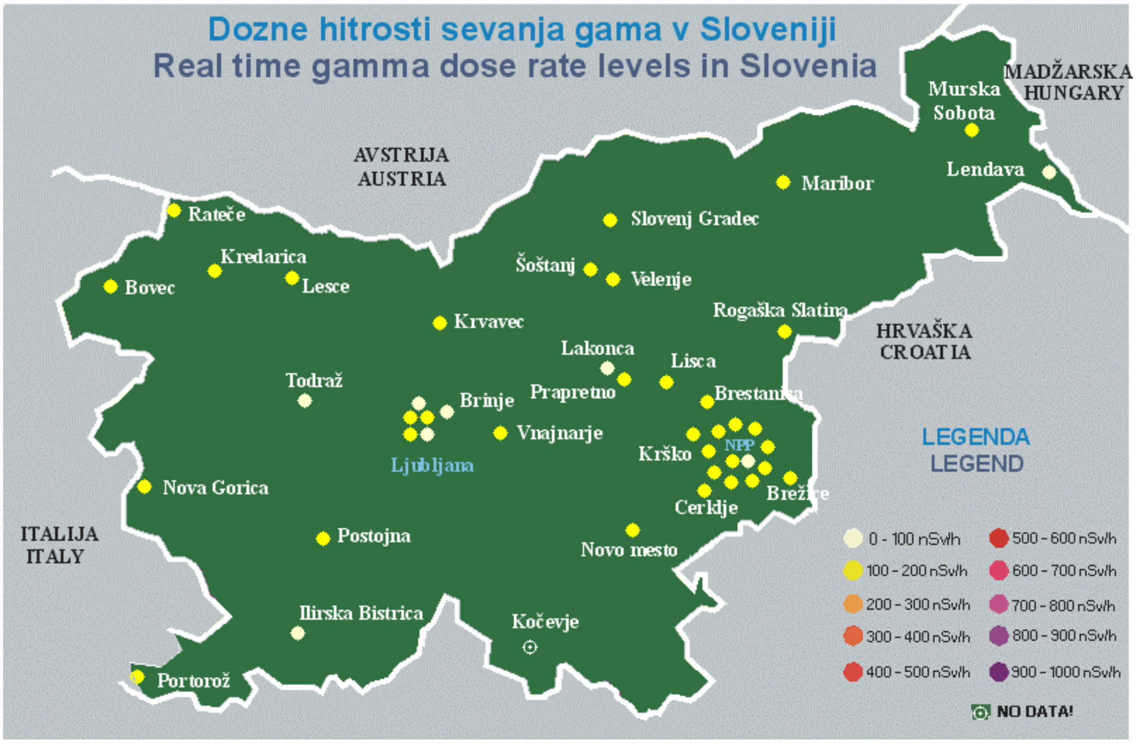

Figure 3.1: Map of Slovenia with probe locations including a colour presentation of radiation ranges.

Table 3.1: Numerical values of real time gamma dose rate levels on the territory of Slovenia.

Type of probe	Avg. dose Rate [nSvh^{-1}]	Max. dose Rate [nSvh^{-1}]	Min. dose rate [nSvh^{-1}]	Availability of data in [%]	Coordinates and name of location
ALNOR	74	140	60	99	14°31',46°04', Ljubljana-URSJV
ALNOR	82	170	70	97	14°08',45°35', Ilirska Bistrica

ALNOR	68	120	60	99	14°31',46°03', Ljubljana-IOS
ALNOR	88	220	60	96	14°36',46°05', Ljubljana-Brinje
ALNOR	94	180	60	99	14°09',46°05', Todraž-RUZV
ALNOR	78	150	60	99	15°31',45°56', Krško-NEK
ALNOR	78	130	60	42	16°28',46°33', Lendava
MFM	119	167	106	99	14°31',46°04', Ljubljana-URSJV
MFM	124	169	94	51	14°29',46°02', Ljubljana-JSI
MFM	132	180	116	96	15°36',45°54', Brežice
MFM	127	200	105	94	15°31',45°53', Cerklje
MFM	110	163	97	90	15°29',45°57', Krško-Videm
MFM	114	164	100	97	15°31',45°56', Krško-NEK
MFM	126	172	111	97	15°31',45°57', Libna
MFM	121	176	107	98	15°32',45°57', Stari Grad
MFM	132	189	113	98	15°33',45°56', Pesje
MFM	134	197	115	98	15°34',45°56', Gornji Lenart
MFM	127	190	107	98	15°33',45°54', Skopice
MFM	132	180	116	93	15°32',45°55', Vihre
MFM	125	179	109	93	15°30',45°55', Brege
MFM	126	202	111	90	15°28',45°56', Leskovec
MFM	114	164	100	82	15°30',45°58', Krško
MFM	128	195	112	96	15°38',46°32', Maribor
MFM	115	168	100	97	15°10',45°48', Novo mesto
MFM	106	210	95	97	13°38',45°53', Nova Gorica
MFM	109	158	97	98	13°35',45°31', Portorož-Secovlje
MFM	116	171	102	96	16°11',46°39', Murska Sobota
MFM	137	220	117	89	13°51',46°23', Kredarica
MFM	132	202	117	92	14°10',46°21', Lesce
MFM	142	196	120	92	15°10',46°28', Slovenj Gradec
MFM	127	203	106	97	14°35',46°18', Krvavec
MFM	126	175	109	93	14°11',45°45', Postojna
MFM	129	213	112	94	14°31',46°03', Ljubljana-HMZ
MFM	162	220	127	93	14°51',45°32', Kocevje
MFM	122	168	110	85	15°07',46°22', Velenje
MFM	123	177	99	77	15°17',46°04', Lisca
MFM	120	178	106	94	15°38',46°14', Rogaska Slatina
MFM	109	176	94	96	13°34',46°20', Bovec
MFM	136	204	113	96	13°43',46°30', Rateče
MFM	108	175	90	81	15°29',45°59', Brestanica
MFM	122	192	108	69	15°03',46°23', Šoštanj
MFM	122	177	104	94	14°40',46°03', Vnajnarje
MFM	94	146	83	64	15°03',46°08', Lakonca
MFM	117	177	99	57	15°05',46°08', Prapretno

A new system for automatic on-line quality control of the incoming data was introduced into the SNSA monitoring system in the year 2001. It promptly controls the content of all data received from the measuring sites. For this purpose a graphical table has been prepared (Figure 3.2). It illustrates the time of the arrival of data to the SNSA and data about the function of the probe.

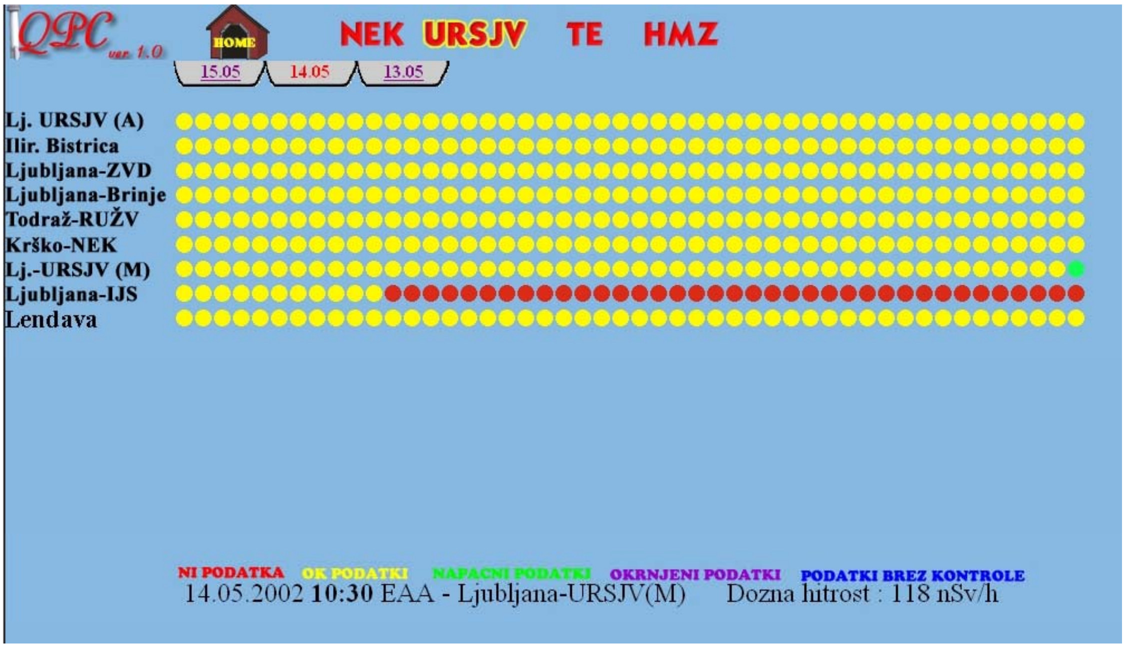

Figure 3.2: Graphical illustration of quality and transmit of data from ALNOR system to the SNSA.

Since 1998 the SNSA has been performing QA/QC analysis for incoming data in the CROSS system and preparing monthly two documents:
"QA/QC monthly report on automatic radiological system in Slovenia"
"Monthly summary report on measurements of the automatic radiological system in Slovenia"

The monthly and yearly summary reports on the results of measurements are elaborated. These reports contain a graphic presentation of dose-rate values and their frequency distributions. Averages, maximal and minimum values of daily dose-rates, frequency distribution of monthly dose-rates and descriptive statistics of results are presented in a graphical form for each location (Figure 3.3).

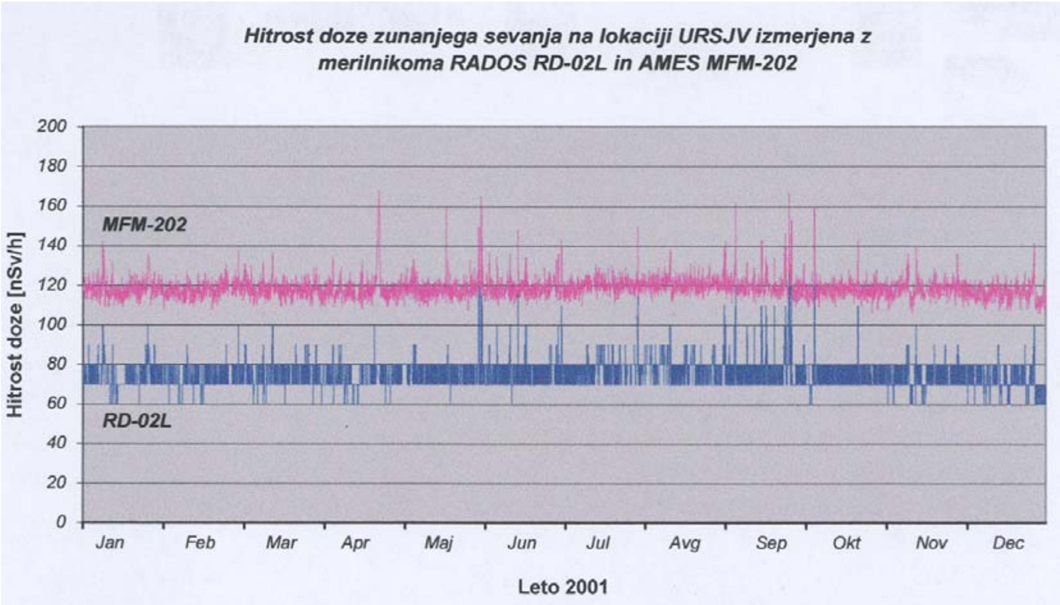

Figure 3.3: Yearly values of gamma dose rate and yearly precipitation for probes located at the SNSA, RADOS (RDL-02L) and AMES (MFM-202).

In the year 2001 the SNSA was sending data weekly from CROSS to the European system EURDEP located in the Joint Research Centre (JRC) in Ispra (Italy). By joining the European network, the SNSA gained the possibility of insight into data from other European countries. All data are checked on-line automatically and are sent daily in accordance with bilateral agreements automatically to Austrian, Croatian and Hungarian authorities. From 2001 Croatia started sending (daily by email) data on external radiation to the SNSA. The locations of the measuring points in the neighbouring countries are presented in Figure 3.4. Figure 3.5 gives the meteorological and ecological data at the location of the Krško NPP.

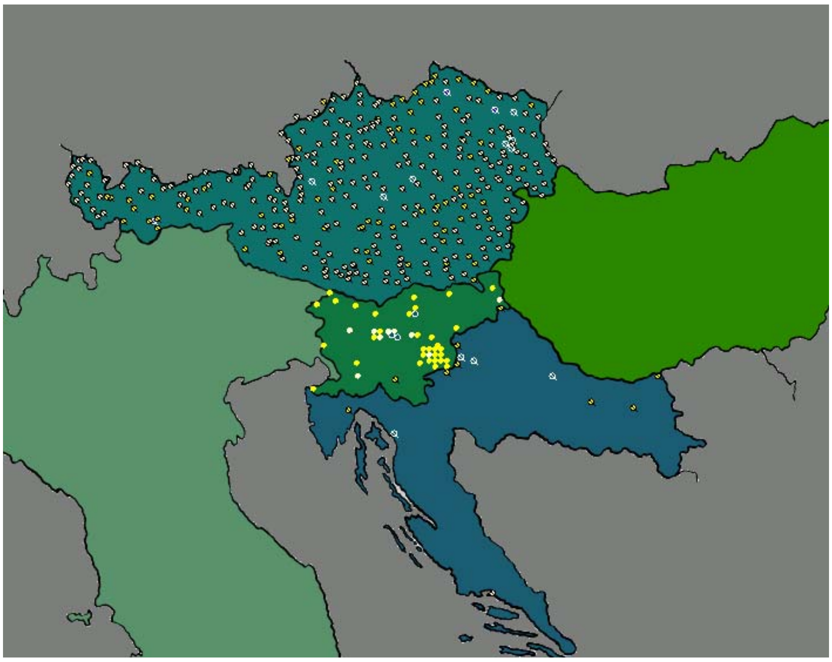

Figure 3.4: Map of external radiation measuring points in Slovenia and its neighbouring countries who are sending the data to SNSA.

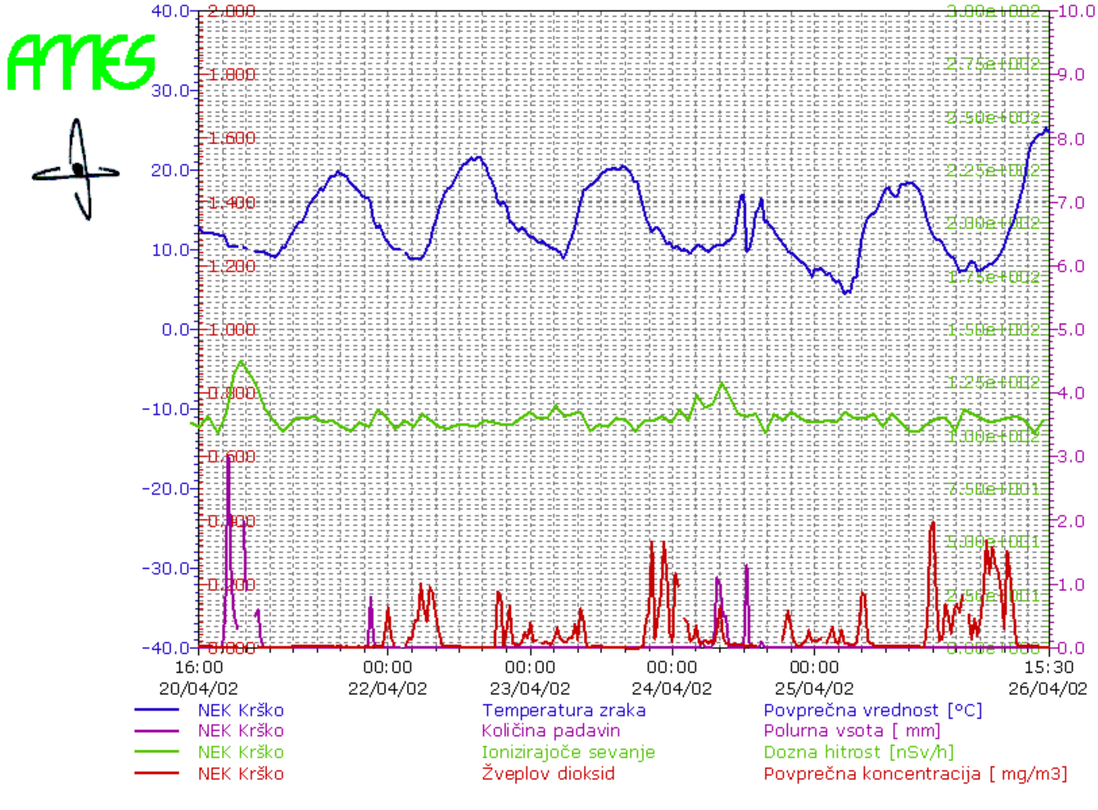

Figure 3.5: Diagram of radiological, meteorological and ecological data at the location of the NPP.

3.1.2 AUTOMATIC MONITORING OF AEROSOL RADIOACTIVITY

In the middle of 1998 the first automatic aerosol monitoring system (AMS-02 a product of BITT Technology Austria) was put into operation at Brinje near Ljubljana (location of the

Research Reactor Centre) by the Slovenian Nuclear Safety Administration. The system was provided in the framework of the IAEA technical co-operation project. The second system was installed by the SNSA in May 1999 at Krško on the NPP site. All automatic aerosol systems continuously pumps the air through a filter and measure the concentration of artificial alpha and beta activity in the air, concentration of gamma emitting radionuclides, concentration of radioactive iodine I-131 in the air in all chemical forms (particles, gas, organically bound iodine) and concentrations of natural radon and thoron progeny. At the end of 1999 the Austrian government granted the SNSA an advanced aerosol monitoring station (AMS-01) with high resolution gamma spectrometry. It is installed at Drnovo near Krško. Provided that there is no increased radioactivity observed in the air, data are presented in terms of detection limits. The detection limits for AMS-01 are: for artificial alpha activity in air 0.01 Bqm^{-3}, for artificial beta activity 0.1 Bqm^{-3}, for Cs-137 in the air 0.10 Bqm^{-3} and for I-131 0.01 Bqm^{-3}.

3.1.3 AUTOMATIC MEASURING SYSTEM OF RADON PROGENY CONCENTRATIONS

Radon progeny measurements represent an additional part of the Slovenian automatic radiation monitoring network. One automatic monitoring station is located at Todraž near Gorenja vas in the very vicinity of the disposal sites of the former Žirovski vrh uranium mine. Six such instruments were kindly provided to Slovenia by the Bavarian government in the framework of bilateral co-operation in 1996. The system is operated by the Žirovski vrh Mine Company with close co-operation of the SNSA. Radon progeny concentrations are measured hourly and are expressed in terms of equilibrium equivalent concentrations of radon (EEC) in Bqm^{-3}.

3.1.4 RADIOACTIVE DEPOSITION MEASUREMENTS

In a nuclear accident, radioactive particles are released into the atmosphere and the flow of air masses may transfer them over a large area, even thousands of kilometres away. During the atmospheric transport process some particles are deposited on the ground (dry deposition), or washed down by precipitation (wet deposition). The upper layer of the ground - including water and vegetation - becomes radioactive, which results in increased values of external gamma dose rates.

When this happens, information on the presence of radioactive contamination on the ground and on its radioisotope composition is urgently needed. For this reason the SNSA developed and installed in Ljubljana an automatic gamma-spectrometry system equipped with a scintillation detector for measurements of radioactive ground deposition. The system is designed for on-line detection and evaluation of possible contamination with fission products such as I-131 and Cs-137. The measuring system for radioactive deposition collects data and performs gamma spectroscopic analysis of the measured spectrum every 6 hours. The measurement time interval can easily be changed. Special software enables on-line evaluation, display and storage of the results of surface ground contamination and alarming. The results are displayed on the SNSA Internet homepage.

Table 3.2: The results of gamma spectrometry measurements in Ljubljana at SNSA location.

	Artificial radioactivity [$kBqm^{-2}$]		Existing contamination [$kBqm^{-2}$]	Natural radioactivity [$kBqm^{-2}$]		Gamma dose rate [$microSvh^{-1}$]
Radionuclide	I-131	Cs-137	Cs-137	Pb-214	Bi-214	
Measured contamination	-	-	1.5	-	-	0.071

The results of gamma spectrometry measurements in Ljubljana at SNSA location are given in Table 3.2.The values of surface ground contamination of the two most characteristic fission products, marker isotopes I-131 and Cs-137, are calculated. The results are based on the assumption of surface-only contamination without taking into account depth distribution. The natural radioactivity is presented as an average surface activity of newly deposited radon daughters Pb-214 and Bi-214 in the last measurement interval. The dose rate was measured with the GM counter at the same location. The detection limits for surface contamination are I-131 0.04 kBqm^{-2} and for Cs-137 0.05 kBqm^{-2} for individual radionuclides.

3.1.5 NOVELTIES IN YEAR 2001

The main novelties on the automatic radiation monitoring system in year 2001 were:
- a new location (Lendava) for measuring the external radiation was included into the automatic radiation monitoring system
- an agreement with the measurement network operators for transfer of the collected and archived data (including ecological and meteorological data) was signed
- introduction of simultaneous control of incoming data and of their quality
- introduction of daily mailing of data from Croatia on the basis of the bilateral agreement
- modified outlook of the SNSA Internet page on radiation monitoring.

All data from probes are analysed, checked, recorded and displayed on the following internet page: http://www.gov.si/ursjv/.

3.2 GLOBAL RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT IN SLOVENIA IN 2001

The basic scope of the programme was determined by the Regulation on Sites, Methods and Time Periods for the Radioactive Contamination Control (Off. Gaz. SFRY, No. 40/86). In 2001, the monitoring programme of global contamination in the living environment in Slovenia was performed in the same extent as in the preceding years.

The monitoring programme was financed by the Ministry of Health of the Republic of Slovenia and was performed by the approved technical support organisations – the Institute of Occupational Safety and the JSI, both from Ljubljana.

3.2.1 MONITORING PROGRAMME

The programme of global radioactive contamination monitoring in the environment covers the following environmental media: surface waters, air, soil, precipitation, drinking water, food stuffs and fodder.

1.Surface waters
A semi-annual grab sampling of water from the Sava river near Ljubljana (Laze-Jevnica), the Drava river near Maribor, the Savinja river near Celje and the Soča river near Anhovo. Specific activity of gamma emitters and H-3 was determined. (Remark: According to the regulations, the river water samples should be collected daily for a period of 3 months; radioactivity of the Mura river has not been monitored).

2.Air
Continuous pumping of air through air filters at the sites in Ljubljana, Jezersko and Predmeja. The air monitoring consists of concentrations measurements of gamma emitters in the monthly composite samples of daily filters. (Remark: according to the regulations radionuclide Sr-90 also should be monitored in monthly samples in Ljubljana).

4.Ground

Soil. Samples of undisturbed grassland are taken in Ljubljana, Kobarid and Murska Sobota. The content of gamma emitters and Sr-90 in three layers of soil (0-5 cm, 5-10 cm and 10-15 cm) was measured twice a year.

5.Ground

External gamma radiation. TL dosimeters were installed at 50 outdoor sites throughout Slovenia, forming a 20 km x 20 km network, for the purpose of determination of semi-annual doses received from external gamma radiation. In addition, continuous measurements of dose rate levels within this programme were performed in Ljubljana, Maribor, Novo mesto, Celje, Nova Gorica, Portorož, Murska Sobota, Kredarica and Lesce.

6.Precipitation

Continuous sampling of dry deposition and precipitation in Ljubljana, Novo mesto, Bovec and Murska Sobota. Specific activities of gamma emitters and H-3 were measured on a monthly basis, while those of Sr-90 were monitored quarterly. (Remark: measurements of plutonium are not performed)

7.Drinking water

Sampling of drinking water from water mains twice a year in Ljubljana, Celje, Maribor, Kranj, Škofja Loka and Koper. The specific activity of gamma emitters, Sr-90 and H-3 was determined. (Remark: collective monthly samples should be monitored in Ljubljana and Maribor).Measurements of dripping water are not included in the monitoring programme even though they are prescribed and a noticeable part of population is supplying with dripping water.

8.Food

Seasonal sampling of the food of animal and plant origin in Ljubljana, Novo mesto, Koper, Celje, Murska Sobota, Maribor and Slovenj Gradec or at other locations when required.
Samples of milk taken in Ljubljana, Kobarid, Bohinjska Bistrica and Murska Sobota (powder milk) were collected daily and analysed monthly. The content of gamma emitters and Sr-90 was determined in all food samples.

9.Fodder, grass

Sampling of grass at sites in Ljubljana, Kobarid and Murska Sobota twice a year. The content of gamma emitters and Sr-90 was determined. (Remark: broader extent of monitoring was prescribed, including factory produced fodder, concentrates and silage)

3.2.2 CONTRACTORS

The monitoring programme was performed by technical support organisations, the Institute of Occupational Safety, Ljubljana, Bohoričeva 22a, and the Jožef Stefan Institute, Ljubljana, Jamova 39. Both contractors are authorised by the Ministry of Health for performing radiological surveillance of the environment. Both of them regularly participate in the international comparative measurements within the IAEA with the purpose of assuring the quality control of measurements. They also carried out additional comparative measurements of samples within the framework of the radioactivity monitoring programme in the surroundings of the Krško NPP.

3.2.3 MEASUREMENT RESULTS

a) Monitoring of river water in Slovenia was not performed according to the regulations; instead of daily collection of samples and analysing a composite quarterly sample only grab sampling was provided twice a year. The Mura river is not controlled in spite of the fact that this water was in the past the most contaminated due to I-131 releases from Austrian hospitals.

The results of measurements of artificial radionuclides in all four largest rivers in Slovenia showed that Cs-137 concentrations could only be found in traces from 0.2 Bqm^{-3} in the Sava river up to a maximum of 0.95 Bqm^{-3} in the Drava river. Levels of H-3 concentration in river water varied between 860 to 2900 Bqm^{-3}, the average value in all four rivers was 1620 Bqm^{-3}, which is almost the same as in year 2000.

Concentrations of the radionuclide I-131 in rivers were measured - released from nuclear medicine centres in Ljubljana, Maribor and Celje. Unexpectedly high concentrations were detected in the Drava river (44 Bqm^{-3}) and in the river Savinja (60 Bqm^{-3}), while in the Sava river (10 Bqm^{-3}) the values were similar to those of the year before. The Soča river is not contaminated with this radionuclide.

b) No major changes occurred in the specific activity of radionuclides in the air as compared to previous years. The levels of Cs-137 were from 2.8 at Jezersko to 4.2 micro Bqm^{-3} at Predmeja. The levels of Sr-90 were not measured. Natural radionuclides such as Be-7 and Pb-210 were in the range of 1.9-2.8 mBqm^{-3} and around 0.5 mBqm^{-3} respectively. Figure 3.6 shows the monthly specific activities of Cs-137, Be-7 and Pb-210 in the air for the period from 1981-2001 on the location of Ljubljana.

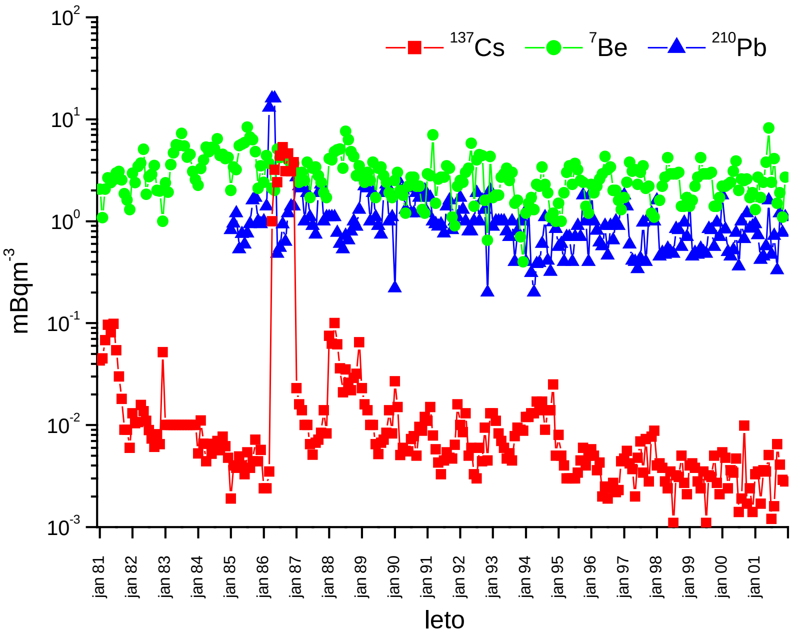

Figure 3.6: Monthly specific activities of Cs-137, Be-7 and Pb-210 in the air for the period 1981-2001 – at the location of Ljubljana (SNSA data processed).

c) Radioactivity measurements of precipitation showed levels of Cs-137 concentration mostly of the order 0.8-1.9 Bqm^{-3} (deposition: 1-4.5 Bqm^{-2}) and for Sr-90 on average 0.07-0.14 Bqm^{-3} (deposition: 0.2-0.7 Bqm^{-2}). The levels are similar to those of the previous year. Sr-90 in precipitation in the nineties was much lower than in the early eighties (0.1-1 Bqm^{-2} versus 1-8

Bqm^{-2}). The deposition of the natural radionuclide Be-7 in Ljubljana was 0.13 kBqm^{-2} and of H-3 1.8 kBqm^{-2}, with the concentration 1.6 kBqm^{-3} in rain water.

d) The results of measurements of artificial radionuclides (Cs-137 and Sr-90) in soil layers indicated that the distribution by depth was very similar to that established in the previous year, with a slight decline from the surface to deeper layers. In Ljubljana, the average specific activity of Cs-137 in the first 15 cm was in total 7.8 kBqm^{-2} (at the time of the Chernobyl accident about 25 kBqm^{-2}) and in Murska Sobota only about 5 kBqm^{-2}. Surface activity of Sr-90 was found to be much smaller and was within the range of about 260 Bqm^{-2} (contamination in 1986: 450 Bqm^{-2}). Almost 30% of this appeared in the upper layer, from 0 cm to 5 cm. The highest contamination of soil (0-15 cm) was measured in Kobarid (0.36 kBqm^{-2}); this, is however lower than in the year 2000, because of the less precipitation in year 2001. In Murska Sobota the measured contamination of Sr-90 in the upper layer was 0.30 kBqm^{-2}. Table 3.3 shows the average annual activities of Sr-90 and Cs-137 in the upper layer from 0 cm to 5 cm, for the period from 1982 to 2001. The data on Sr-90 for the years 2000 and 2001 are not reliable.

Table 3.3: Mean annual activities of Sr-90 and Cs-137 in the soil layer at a depth of 0-5 cm for the period 1982-2001.

Mean annual activities [Bqm^{-2}] *						
	Ljubljana		Kobarid		Murska Sobota	
Year	Sr-90	Cs-137	Sr-90	Cs-137	Sr-90	Cs-137
1982	126		222		69	
1983	157*		161		43	
1984	102		161		48	
1985	107		154		56	
1986	123		680		115	
1987	115	25500	465	32250	90	4850
1988	120	8600	395	5950	84	2750
1989	129	6800	384	15000	89	3200
1990	130	12500	335	8350	81	6200
1991	80	11000	240**	7750	73	4350
1992	82	9350	255	14000	71	5050
1993	94	10500	280	16500	54	4650
1994	77	7400	230	10100	70	4550
1995	71	8000	210	10500	79	3950
1996	43	6200	145	9700	59	4000
1997	27	5750	67	6500	40	4400
1998	29	4400	73	5700	23	3000
1999	41	3800	73	5700	88	3000
2000	54	3500	220	5300	94	3000
2001	105	3450	145	4750	99	2450

* Sampling and measurements by IOS
* * Change of sampling location

The measurements of external gamma radiation showed that the average value in Ljubljana in 2001, measured with TL dosimeters, was estimated to be 91 nSvh^{-1} and is lower than in 2000 (98 nSvh^{-1}). The dose contribution of the Chernobyl contamination in the Ljubljana region was estimated to be still about 0.14 mSv per year, i.e. 20 % of the value of natural background (0.7 mSv/year). In 2001 the average dose rate in the country, measured with automatic radiation monitors on 12 locations, was 124.5 nSvh^{-1}. This value is 25% higher than the ones obtained with the TL dosimeters at the same locations. No explanation for this difference has been given. Table 3.4 shows the doses (measured with TLD) from external radiation in Slovenia in the year 2001.

Table 3.4: Annual dose from external radiation in Slovenia in 2001, measured with TL dosimeters.

Nr. TLD	Location	Annual dose [microSv]									Measured dose in period [microSv]		Annual dose	Average monthly dose in period [microSv/month]		
		1992	1993	1994	1995	1996	1997	1998	1999	2000	from 12.12.00 to 15.6.01	from 15.6.01 to 9.1.02	2001	from 12.12.00 to 15.6.01	from 15.6.01 to 9.1.02	annual
1	Kočevje	1142	1099	964	907	907	890	906	870	945	394	527	855	65	77	71
2	Dvor pri Žužemberku	1032	943	954	955	888	929	927	832	909	392	440	771	64	64	64
3	Črnomelj	1197	1163	1163	1089	1090	1046	1022	1035	1092	490	586	998	81	86	84
4	Drašiči (Metlika)	874	827	820	835	828	816	817	801	850	412	447	795	68	65	67
5	Novo mesto	733	807	730	708	692	698	688	659	704	313	352	617	51	52	51
6	Mokronog	968	924	940	910	926	908	893	858	949	440	471	844	72	69	71
7	Lisca	922	852	872	883	835	***	712	636	783	353	343	643	58	50	54
8	Celje	883	839	858	860	843	818	799	775	802	413	437	786	68	64	66
9	Rogaška slatina	869	811	835	811	787	781	770	747	816	388	427	754	64	62	63
10	Slovenske konjice	938	897	893	875	846	845	809	775	936	405	468	808	67	68	68
11	Rogla	1308	1016	1096	1118	1164	1141	1134	1094	1096	621	616	1144	102	90	96
12	Maribor	843	825	862	834	782	774	747	696	814	341	395	683	56	58	57
13	Ptuj	1005	*(3288)	910	907	911	890	880	831	944	447	463	842	73	68	71
14	Jeruzalem (Ormož)	874	829	844	830	825	824	795	759	844	386	460	784	64	67	66
15	Lendava	938	798	840	880	889	876	847	847	888	456	480	866	75	70	73
16	Murska Sobota	757	729	754	730	728	739	747	715	762	364	420	727	60	61	61
17	Veliki Dolenci	944	842	863	874	871	863	842	849	912	424	491	848	70	72	71
18	Gornja Radgona	923	840	1031	849	844	855	825	817	871	417	450	802	69	66	68
19	Svečina	956	920	937	913	887	912	881	856	977	411	525	869	68	77	73
20	Ribnica na Pohorju	982	908	929	935	910	906	890	854	968	472	492	892	77	72	75
21	Kotlje	1108	1013	1015	1025	994	965	952	909	963	447	518	894	73	76	75
22	Velenje	805	819	854	845	836	826	824	821	795	391	443	772	64	65	65
23	Mozirje	763	798	796	801	786	823	809	781	830	389	403	733	64	59	62
24	Luče	931	881	882	873	859	821	845	801	872	412	458	806	68	67	68
25	Vače	931	880	893	855	825	867	841	845	958	437	453	823	72	66	69
26	Ljubljana-Bežigrad	936	852	840	811	831	848	828	775	782	363	409	715	60	60	60

64	Ljubljana-Vič	975	904	876	872	844	854	844	839	845	416	477	827	67	68	68
27	Brnik-Aerodrom	664	657	664	841	988	995	974	916	1029	443	546	918	73	80	77
28	Jezersko	811	762	769	721	704	683	678	623	688	318	348	617	52	51	52
29	Podljublelj	930	881	873	830	796	758	806	684	753	357	374	676	59	55	57
30	Lesce-Hlebce	1045	972	978	980	965	940	941	901	910	422	502	857	69	73	71
31	Planina pod Golico	1135	1041	1071	964	948	968	991	912	1005	452	547	926	74	80	77
32	Zdenska vas	1120	1010	1047	1031	1036	1004	972	951	982	439	512	881	72	75	74
33	Rateče	1012	985	971	889	922	907	897	860	869	419	497	849	69	73	71
34	Trenta	965	842	848	791	751	720	710	668	703	345	374	666	57	55	56
35	Log pod Mangartom	1277	1141	1111	1045	1026	962	981	922	982	464	470	864	76	69	73
36	Bovec	797	746	726	731	724	674	677	711	756	383	409	733	63	60	62
37	Tolmin	800	760	763	761	754	714	710	709	734	340	400	686	56	58	57
38	Nova Gorica, Bilje	777	733	692	629	636	619	610	603	613	302	337	591	50	49	50
39	Novelo	744	714													
39	Brdice pri Kožbani			626	635	641	627	624	606	643	323	339	612	53	52	53
40	Lokev	1069	928	988	914	920	925	874	879	913	433	487	852	71	71	71
41	Portorož	624	621	663	655	648	621	612	613	671	317	342	610	52	50	51
42	Ilirska Bistrica	798	688	713	701	702	687	679	697	724	356	371	672	59	54	57
43	Postojna-Zalog	906	849	864	868	839	851	829	802	851	408	454	798	67	66	67
44	Nova vas na Blokah	1186	1017	1082	1057	1032	1046	1014	978	1092	529	590	1036	87	86	87
45	Vrhnika	1535	1345	1307	1232	1203	1245	1239	1204	1240	557	678	1145	92	99	96
46	Vojsko	897	891	992	810	893	1027	884	786	825	408	475	819	68	70	70
47	Sorica	802	731	757	713	722	716	736	724	711	333	411	690	55	60	58
48	Stara fužina	951	898	866	844	779	789	819	767	766	380	428	748	62	63	63
49	Jelenja vas**						1319	1320	1315	1362	631	727	1259	104	106	105
50	Kredarica	828	795	792	728	762	751	695	736	744	335	433	713	55	63	59
No. of measuring points		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Avg. no. of meas. points		944	878	888	863	856	852	837	807	862	405	455	797	67	67	67
Standard deviation (+/-)		171	136	138	124	126	132	128	123	130	63	74	124	10	11	10
Maximum dose		1535	1345	1307	1232	1203	1245	1239	1204	1240	621	678	1145	102	99	96
Minimal dose		624	621	626	629	636	619	610	603	613	302	337	591	50	49	50

* The dose is not included in the calculation of the average – the dosimeter registered an additional dose because of radiographic research in the surroundings

** New measuring point – expected dose increase – the dose is not included in the calculation of the average
***Dosimeter from the first half-year was lost, the cause of increase registered by the dosimeter from the second half-year was not be establised.

f) Radioactivity of Cs-137 in drinking water from the public water supply in bigger towns in Slovenia was found only in trace quantities, i.e. 0.08-0.35 Bqm^{-3}. Concentration of Sr-90 was for unexplained reasons several times higher than that of Cs-137 (in Koper even 2.9 Bqm^{-3}). Concentration of H-3 in tap water was in the same range as in river water (1230 Bqm^{-3}).

g) The decreasing trend in the specific activity of radionuclides Sr-90 and Cs-137 in food was found also throughout 2001, as in previous years. The mean value of Cs-137 in vegetables and fruit was mostly in the range of 0.06 $Bqkg^{-1}$, and in cereals (barley, buckwheat, oats) 0.7 $Bqkg^{-1}$, which is lower than in the year 2000. The highest value was measured in whortleberry, 44 $Bqkg^{-1}$, at Ravne. The contents of Sr-90 in cereals, fruits and vegetables were in the equal range as in the previous year, namely on average 0.2 $Bqkg^{-1}$. As for the food of animal origin, meat contained in average from 0.02 $Bqkg^{-1}$ to 0.2 $Bqkg^{-1}$ which is the same as the year before. Cow milk from central Slovenia had on average 0.14 Bql^{-1} of Cs-137 and 0.09 Bql^{-1} of Sr-90, while milk samples from the alpine region (NW) of Slovenia showed values of 0.37 Bql^{-1} Cs-137 and 0.14 Bql^{-1} of Sr-90. Table 3.5 shows the average annual activities of Sr-90 and Cs-137 in milk in the period from 1984 to 2001. Higher contents of Sr-90 were found in cheese samples (0.54-0.93 $Bqkg^{-1}$) while the levels of Cs-137 were 0.043-0.64 $Bqkg^{-1}$ .They are an order of magnitude lower than in the previous year but the reason for this is unknown. Generally speaking, the great variability of very low absolute values for Cs-137 and Sr-90 (near detection limit) does not enable good statistical comparability of the results.

h) Contents of Cs-137 and Sr-90 in grass showed levels of the order of magnitude of 1 $Bqkg^{-1}$ of fresh samples. Levels of Cs-137 were on average 1.4 $Bqkg^{-1}$ and were more or less permanently several times lower than the levels of Sr-90 (mean value 4.2 $Bqkg^{-1}$); these results are very similar to those in previous years. By far the highest contamination of grass originates from the natural long-lived radon decay product Pb-210 content (due to dry and wet deposition from the atmosphere); the average level was 12 $Bqkg^{-1}$, and for the cosmogenic radionuclide Be-7 the determined levels were around 78 $Bqkg^{-1}$.

Table 3.5: Mean annual activities of Sr-90 and Cs-137 in milk in the period 1984-2001.

Mean annual activities [Bql^{-1}]						
	Sr-90			Cs-137		
Year	Ljubljana	Kobarid	Murska Sobota *	Ljubljana	Kobarid	Murska Sobota *
1984	0.17	0.33	0.21	0.13	0.27	0.09
1985	0.19	0.33	0.22	0.10	0.27	0.09
1986	0.28	0.81	0.27	21.5	65.7	15.33
1987	0.40	0.87	0.25	0.40	0.87	0.25
1988	0.22	0.53	0.20	1.49	7.32	1.56
1989	0.17	0.38	0.18	0.68	6.0	0.68
1990	0.19	0.43	0.18	1.10	4.9	0.51
1991	0.16	0.36	0.19	0.58	3.5	0.39
1992	0.22	0.32	0.23	0.41	4.0	0.37
1993	0.15	0.30	0.15	0.47	2.9	0.29
1994	0.14	0.22	0.13	0.48	2.0	0.21
1995	0.12	0.22	0.15	0.45	1.7	0.23
1996	0.13	0.29	0.13	0.36	1.2	0.18
1997	0.10	0.15	0.09	0.12**	0.55	0.18
1998	0.10	0.15	0.09	0.10**	0.65	0.15
1999	0.09	0.16	0.11	0.25	0.55	0.15
2000	0.08	0.15	0.10	0.23	0.23	0.10
2001	0.09	0.14	0.08	0.14	0.20	0.14

* Values for fresh milk are calculated from the measured values of powder milk
** A different area of sampling

Source:

– Radioactivity in the living environment of the Republic of Slovenia in year 2001, IOS, No. 1004/02, Ljubljana May 2002.

3.2.4 EXPOSURE DUE TO GLOBAL RADIOACTIVE CONTAMINATION

On the basis of average specific activities of the long-lived fission radionuclides in the air, water and food for 2001, and the average annual intake, taking into account the dose conversion coefficients according to IAEA Basic Safety Standards (1996), the cumulative effective dose of E_{50} was estimated. The contribution of both radionuclides to the dose due to inhalation was estimated to be actually negligible in comparison with the doses received by other transfer pathways. This contribution was estimated to be a few nSv in the case of Cs-137 and a few tens of nSv in the case of Sr-90. The ingestion dose amounted to 4.2 microSv per year, of which Sr-90 accounted for 80% of the dose and Cs-137 for 20%. The external radiation caused by the soil contamination with Cs-137 represented the largest contribution to the global contamination of the environment in 2001. The measuring data from Ljubljana were used for the estimation of the annual dose due to external radiation. On the assumption that every inhabitant spends 30% of the available time outdoors, the effective dose due to external radiation (mostly from the Chernobyl accident) was estimated to be 50 microSv. The cumulative dose to an adult, caused by the global contamination of the environment with both long-lived fission radionuclides, was estimated to be 54.2 microSv/year, as shown below (Table 3.6). In the areas with higher Chernobyl contamination (NW part of Slovenia) the contribution to the total dose is higher, up to 0.9 microSv/year, due to ingestion of artificial radionuclides in milk.

Table 3.6: Exposure to the population in 2001 originating from global contamination of the environment with long-lived fission radionuclides.

Transfer pathway	Effective dose (in microSv/year)
Inhalation (Cs-137, Sr-90)	0.02
Ingestion : food (Cs-137, Sr-90) drinking water (rain water tanks, Cs-137, Sr-90, 2 l daily) drinking water (Sava river, I-131, 2 l daily	4.2 (0.05)* (0.5)*
External radiation	50.0
Total in 2001	54.2 microSv

* Estimation by the SNSA, based on the measured value in the IOS report and conservative assumptions

3.2.5 CONCLUSIONS

Considering the results of monitoring of radioactive contamination in the living environment in the Republic of Slovenia in the year 2001, the technical support organisations claimed that the specific activities of artificial radionuclides in air, water and food were much than the value prescribed by the Regulation on Radioactive Contamination Limits of the Human Environment and on Decontamination (Off. Gaz. SFRY, No. 8/87).

The annual effective doses due to ingestion of artificial radionuclides are comparable to those obtained in the neighbouring countries (e.g. Austria and Switzerland - 5 microSv), while the assessment of external exposure for the Slovenian territory is probably overestimated (50 microSv). The annual exposure from external radiation should be estimated on other, less conservative assumptions (staying outdoors 7.2 hours daily, shielding factor in dwellings 0.1) to be comparable with results in the neighbourhood. In the annual reports for countries like

Austria, an annual external dose of 15 microSv per year was quoted (6 hours outdoors and shielding factor of buildings 0.1), for Germany 20 microSv, and for Switzerland 10-500 microSv per year was reported (staying outdoors for 24 hours).

3.3 RADIOACTIVITY MONITORING IN THE ENVIRONMENT OF THE KRŠKO NUCLEAR POWER PLANT

3.3.1 SCOPE

The regular monitoring at the Krško NPP includes monitoring of the inventory of liquid and gaseous discharges at the source (undiluted emission monitoring), and an independent off-site surveillance programme of the nearby surroundings (environment monitoring). The off-site monitoring predominantly comprises surveillance of an area extending up to a radius of 12 km around the facility - where the highest impacts are anticipated and possible changes should first be detected - while surveillance of the Sava river and groundwater extends up to 30 km downstream into the Republic of Croatia, from Jesenice (at the Slovenian-Croatian border) to Podsused. This report also includes some reference data which are relevant to emergency preparedness in Croatia with regard to early detection of gaseous effluents and their ground deposition. They are collected from measuring sites at larger distances from the plant (14 km to 27 km) towards Zagreb and its vicinity (continuous dose rate monitors, passive TL dosimeters placed along a 45 km arc around the west of the city).

3.3.2 PARTICIPATING INSTITUTIONS

Continuous monitoring of discharges is routinely performed by the Krško NPP and is supervised periodically with comparative, parallel measurements of representative samples done by external authorised institutions. Regular off-site monitoring is performed (following the approved yearly programme by the following institutions: the JSI and the Institute for Occupational Safety from Ljubljana, and on the Croatian territory, the Rudjer Bošković Institute - Centre for Marine and Environmental Research (IRB) and the Institute for Medical Research and Occupational Health, Zagreb (IMI). IRB also performs some measurements of the Sava river from Krško to Jesenice, parallel to those performed by JSI.

3.3.3 RESULTS OF MONITORING

The contributions of general contamination to the radiation burden of the environment, predominantly due to the presence of Chernobyl (Cs-134 and Cs-137) isotopes (as well as the effects of their technological concentration in the emissions of local industry with massive processing of polluted raw materials), after a rapid decline in 1987, underwent a steady decrease during the next seven years, while agricultural products reached pre-Chernobyl levels already by 1990. In 1994 this trend reached its lowest value and during the next few years the standard sample collection of agricultural products from the Krško - Brežice region showed even a slightly higher content of isotopes. A decrease was again observed from 1997 to 1999, while during the year 2000 the presence of caesium in some agricultural products was again somewhat increased. An increase was also noted in ground deposition (dust, precipitation) and in external radiation doses. With reference to the previous year of 2001, the average dose due to external radiation in the surroundings of the Krško NPP decreased, but failed to reach the level of 1999. In 2001, a noticeable decrease in the average yearly dose was also recorded in other regions of Slovenia, where the level fell below that of 1999.

As in several previous years, because of the reduced concentration of caesium, pre-Chernobyl Sr-90 maintained and increased its relative importance among the long-lived artificial radionuclides in the Sava waters. The prevailing share in dose burden from artificial radionuclides, however, is due to short-lived I-131, predominantly contributed since 1990 by hospitals.

For the year 2001, taking into account the increase in H-3 concentration from the Krško NPP effluents as well as I-131, caesium and Sr-90 isotopes, it was estimated that the operational contribution of the Krško NPP to the annual dose burden of the reference man due to potential drinking of Sava water at Brežice was less than 0.5 microSv/year, and for the reference child (of the age 1 - 2 years) it was less than 1.4 microSv/year. For the child this amounts to approximately 8 % of the estimated total dose burden caused by artificial and natural radionuclides together. The estimates are comparable with those for the years 1999 and 1998. Taking into account the recent changes in dose factors, they are also comparable within an order of magnitude with the results of previous years. A somewhat lower dose burden due to the Krško NPP (0.4 microSv/year for reference man, and 1.1 microSv/year for a child) was assessed at Jesenice (border with Croatia). These data are rather sensitive to the somewhat uncertain estimate of the contribution of short-lived I-131 released from hospitals during 2001, as in previous years. A rough estimate of the I-131 contribution from hospitals to the dose burden of the reference child (age 1 - 2 year) can be made from the data taken at Krško, where the effluents of the Krško NPP are excluded. This yields a dose of 1.2 microSv/year.

The estimated dose increase due to ingestion of fish from the river Sava, using rather conservative assumptions (the highest detected concentrations of man-made radionuclides - regardless of the origin; fish as a whole) yields a value of less than 1.3 microSv/year for the reference man and less than 3.1 microSv/year for the reference child (with 60 % of adult consumption). Fish, which represented a critical pathway for Krško NPP effluents to the food chain until 1986, did not show any significant difference in the caesium content (predominantly from Chernobyl) in comparison with the average values in other protein food in 2001. Short-lived I-131, which contaminates Sava waters upstream and downstream of the Krško NPP, also here occasionally causes predominant dose increases (especially to children).

An independent model assessment of the effective dose to the potentially most exposed members of the general public from the reference group of inhabitants at Brežice, for different transfer pathways through the river Sava, based on a dilution factor estimated from measurements and the yearly inventory of liquid discharges from the Krško NPP (supplemented monthly reports of the Krško NPP for the year 2001), was also made. For the year 2001 it yielded an effective dose of 0.5 microSv/year for an adult (over 17 year), 0.4 microSv/year for teenagers (12-17 year), 0.9 microSv/year for a child (1-2 year) and 0.3 microSv/year for babies (less than 1 year). This estimated dose is close to those made for the previous three years.

In the eighties (from 1982) during the operation of the Krško NPP the concentration of H-3 in drinking water from the Brežice water supply was twice as high as that in other water boreholes in the Krško-Brežice plain and in the Krško water supply. Studies and analyses made in 1985 confirmed the assumption that the increase was due to the Krško NPP contributions of H-3 through Sava water. Since the second half of 1990 the Brežice drinking water was predominantly (70 %) supplied from a new, deeper water well with exceptionally low H-3 content, so that connections to Sava waters were disrupted. Therefore, after 1990 the contributions of all man-made radionuclides from the Brežice tap water to the dose of reference man through drinking was reduced to a few percent of a microSv/year (in the y. 2001 around 0.020 microSv/year for an adult, and 0.026 microSv/year for a child) with negligible contributions of the Krško NPP through the old water well. The total dose burden due to the presence of natural and man-made radionuclides in drinking water in Brežice was estimated to be 5 microSv/year for adults, and 12 microSv/year for children (age 1 - 2 year.). The results are two times higher compared with Brežice because of the higher concentration of H-3 and Sr-90. During the year 2001 control bores in the alluvial ground in the Samobor area (Croatia) did not show any significant influence of global contamination, nor any influence of the Krško NPP (H-3).

During the outage works in the NPP (May, June 2001) the off-site measurements of continuously collected aerosols were detected the presence of fresh, short-lived isotopes. The detected concentrations gave an estimate dose 0.14 microSv/year for adults and 0.17 microSv/year for children (1-2 year). The estimates based on an inventory of gaseous emissions (monthly reports of the Krško NPP for 2001, completed with data from JSI for gaseous emissions of tritium and C-14), emissions of particulates (monthly reports of the Krško NPP for 2001 complemented with additional filter measurements from JSI) and averaged monthly dispersion factors (meteorological reports of the Environmental Protection Agency), yielded as the highest dose burden from inhalation (0.13 microSv/year) as well as external radiation caused by the plume (0.11 microSv/year), a total dose of 0.24 microSv/year at the settlement of Spodnji Stari grad (direction ENE at a distance of 0.8 km). This dose is a bit higher compared to year 2000 because of the dose contribution of radiation from cloud. The highest contribution was in may when the outage works were started. This dose was strongly influenced by the higher contribution during the first half of the year, but was lower than the one for the year 2000 because of a reduced inhalation dose. Continuous measurements of airborne I-131 at 6 sites in the surroundings of the plant did not record I-131 above the lower measuring limit, which corresponds to the thyroid yearly dose caused by inhalation (< 0.4 microSv).

The average dose value due to external radiation measured at 57 sites with TL Dosimeters in the vicinity of the Krško NPP throughout the year 2001 was 768 microSv/year. This value was about 3 % lower than in the year 2000, but still above the value for the year 1999, and 30 % higher than before the Chernobyl contamination. A slightly less than 8 % decreased in the average dose was also measured in other regions of Slovenia (50 permanent sites), where since the beginning of measurements in 1991, the average yearly dose has reached higher absolute values than in the Krško - Brežice region. Compared to the average values in 2000, the average dose at the plant fence (9 measuring points) in the year 2001 showed a 6 % decrease (34 microSv/year). The highest increase observed during the year as regards the year 1999 was at the western side of the fence and amounted to 60 microSv/year.

The performed comparative measurements of liquid samples and filters made by the Krško NPP and the JSI, showed an expected agreement with regard to the detected radionuclides. The parallel measurements on proportionally composed representative samples of liquid effluents from the NPP and the parallel measurements of aerosol filters from the programme B showed no significant differences which would importantly change the estimation of the annual burden of gaseous and liquid emissions. In all cases of such differences, the less favourable values were used for the estimation of the burden.

3.3.4 DOSE ASSESMENT

Table 3.7 shows the partial and total exposure of individual members of the population through all transfer pathways due to the Krško NPP releases in 2001, for adults and children, and Table 3.8 presents a survey of the sources and dose values to population in the vicinity of the Krško NPP in 2001.

The stated annual dose values are expressed in microSv /year and are valid in all adequate cases (except for the external radiation) for the quantity, which is defined as a 70-year (for the children of age1-2) or 50-year (for the adults) committed effective dose.

For the dose assessment in the Annual Report (1997) the dose factors are taken from IAEA BSS (SS No. 115), which mainly decreases the estimations for adults and increases those for the children. Because of this, the children of age 1-2 were included in the reference population group together with the adults. Of all age groups the children of age 1-2 are expected to be the most exposed. For of the Sava transfer pathways (modified LADTAP programme) the model of dose assessment was adapted in 1999, applying new dose factors.

The legitimate annual dose limit for effective dose for the member of the public is the 1000 microSv/year. The limit is valid as the collective contribution of all artificial radiation source, with the exception of medical sources, and the contribution of modified natural radiation sources, except for radon in houses.

Besides the legal general dose limits there are also limits which are valid for the normal operating of nuclear facilities, the so-called authorised dose limits, which are lower than the basic limits. According to the decision of the RS Secretariat for Urban Planning (No. 350/F-15/69 from 8 August 1974) the dose limit value for the people living on the edge of the NPP protective zone (radius 500 m from the reactor) is 50 microSv/year. And according to the decision of the RS Committee for Environmental Protection and Spatial Planning (No. 350/F-6/88-DF/JV from 2 August 1988), approved by the RS Sanitary Inspectorate (No. 531-4/531/73-34/P from 21 January 1988), the dose limit value at the fence of the NPP is 200 microSv/year. By a decision of the RS Energy Committee (No. 31-04/83-5 from 6 February 1984) there are some other limitations, e.g. a limit on the annual activity of fluid effluents.

Table 3.7: Partial and total exposure of individual members of the population through all transfer pathways due to Krško NPP releases in 2001.

Transfer pathways*	Annual Effective Dose (microSv)	
	Adults	Children
Internal exposure through inhalation - H-3, C-14, I-131, particulates	0.13	0.07
Internal exposure through ingestion - food - water	< 1.4 < 0.5	<3.3 <1.4
External exposure through submersion and deposition	11	11
Total effective dose due to Krško NPP releases in 2001	13.0	15.8

*The explanation is given in the next table

Table 3.8: Survey of sources and dose values to the population in the vicinity of the Krško NPP in 2001.

1 INTERNAL EXPOSURE (due intake and presence of radionuclides in the body and their radiation effects to the body)	Effective dose (1,2) (microSv/year)	
	Adults	Children 1-2 years
1.1 due to intake by breathing (inhalation) from the following sources:		
1.1.1 natural radioactivity - radon-222 and its short-lived progeny in the air (3)	1300	
1.1.2 general contamination with dust particles (aerosols) - accumulated lead-210 (from industrial and natural sources) - resuspended artificial radionuclides	36 0.004	18 0.002
1.1.3 gaseous emissions from the Krško NPP - H-3, C-14, I-131, particulates	0.13	0.07
Total for inhalation	1336	
1.2 due to intake with food and water (ingestion) from the following sources(4):		
1.2.1 natural radioactivity - K-40 - uranium and thorium chain - other total	180 140 40 360	
1.2.2 general contamination (Chernobyl, nuclear explosions, industrial		

accumulation of artificial radionuclides) - food - water total	 3.3 0.064 3	 4.3 0.06
1.2.3 liquid effluents (the Sava river) and gaseous (deposition) emissions from the Krško NPP - food - water total	 < 1.4 < 0.5 2	 <3.3 <1.4
Total for ingestion	365	
Rounded total for internal exposure	1700	
2 EXTERNAL EXPOSURE (as a result of radiation sources outside the body in the environment and their radiation effects on the body)		
2.1 due to medical diagnostics (5)	300 to 1500	
2.2 due to natural radiation (cosmic and terrestrial) (6) - cosmic neutron component - cosmic and terrestrial radiation (U, Th chain, K-40, cosmic radiation)	 60 770	
2.3 due to Chernobyl deposition in the environment (7)	50	
2.4 due to gaseous emissions from the Krško NPP (inert gases and deposition) (7)	11	
Rounded total for external exposure	2400	
Total for internal and external exposure (rounded) with higher medical contribution (1500 microSv/year) with lower medical contribution (300 microSv/year)	 4100 2900	

(1) The estimations were made using the dose conversion coefficients adopted by the European Community in 1996 (EU Council Directive 96/29/EUROATOM from 13 May 1996; OJ No. - 159, 29 June 1996, p.1)

(2) The dose from artificial radionuclides (the Krško NPP, global contamination) is defined as the "50-year committed effective dose" (for adults) and "70-year committed effective dose" (for children age 1-2), while the dose from natural radionuclides is defined as the "annual effective dose".

(3)For dwellings with an average equilibrium radon concentration of 15 Bqm^{-3} (or a concentration of Rn-222 of 38 Bqm^{-3} at an equilibrium factor of 0.4) and an indoor occupancy factor of 0.8 and an outdoor occupancy factor of 0.2. According to the proposal of the ICRP Publication 65 from 1993, an inhabitant living in the environment with an average equilibrium radon concentration of 22 Bqm^{-3} and spending 80% of his time at home and 20% at work, would receive the same annual dose. The latter concentration values are closer to those measured in Slovenia (M. Križman et al., Proceedings, Symposium on Radiation Protection in Neighbouring Countries in Central Europe - 1995, Portorož, Slovenia, p. 66, January 1996).

(4)Consumption determined on the basis of data of the Statistical Office of Slovenia on Consumption by the Population from 1993 to 1996 (Statistical Yearbook of Slovenia). The data from the publication UNSCEAR 1988 Report (p. 95), United Nations, New York 1988, were used for the average dose from natural radionuclides.

(5)Data obtained from the German government report for 1987 (Bericht der Bundesregierung über Umweltradioaktivität und Strahlenbelastung für das Jahr 1987, Drucksache 11/6142, 20 December 1989). A very approximate estimate for the Slovenian population suggests roughly the same or a little higher exposure, due to inferior equipment at a lower number of examinations. Due to the unreliability of the estimation, the relatively lowest estimation of 300 microSv/year, given in the British NRBP (Radiation Exposure of the UK Population - 1988 Review, NRBP-R227) is quoted here as well.

(6)Data obtained from the report by U. Miklavžič et al., Annual Doses of External Radiation in Slovenia, JSI DP-6696, March 1993 and from UNSCEAR 1988 Report (p.95) UN, New York 1988

(7)Estimation is done on several years measurement basis (JSI) with TL Dosimeters in vicinity of Krško NPP and other sites in Slovenia and with the ZL Dosimeters measurements in living environment (house) in vicinity of Krško NPP in year 1998. It is assumed a longer outdoor stay, with an outdoor occupancy factor of 0.3 and an indoor stay factor of 0.7, was assumed.

The burdens are estimated (1) for adults or for children of age 1-2 (numbers are in brackets) for a reference group which receives the highest dose and consumes exclusively locally produced food. The burdens by the natural radionuclides, where there are no values in brackets, are valid only for adults. The data from the table are graphically presented on the diagram.

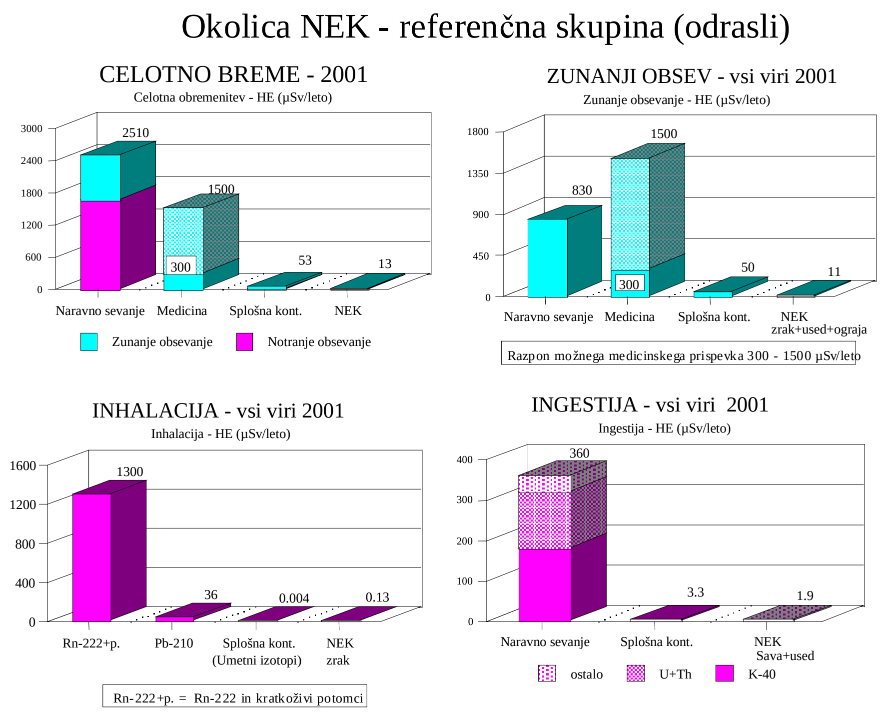

Figure 3.7: Dose assessment for adult residents of the reference group in the vicinity of NPP Krško in the year 2001.

On Figure 3.7 the assessment for adult residents of the reference group in year 2001 from all natural and artificial sources including contribution of Krško NPP.

Source:

– Radioactivity monitoring in the environment of NPP Krško – Report for the year 2001, JSI, no. JSI-DP-8340, Ljubljana, March 2002

3.3.5 CONCLUSIONS

All monitored and quantitatively evaluated radiation burdens in the environment due to release from the Krško NPP were below the regulatory limit of 50 microSv/year. The conservatively estimated dose burdens received by members of the reference (critical) population group as the result of directly measured values in the environment and on model calculations from the data for annual release values from the Krško NPP, in the year 2001, amounted to a value of effective dose smaller than 20 microSv/year. This value represents less than 1 % of the annual dose received from natural and artificial sources by a member of the general public in the normal environment.

3.4 RADIOACTIVITY MONITORING IN THE ENVIRONMENT OF THE TRIGA RESEARCH REACTOR

In 2001, the radioactivity monitoring programme in the environment of the Research Reactor at Brinje was carried out in accordance with the Regulation on Radioactivity Monitoring in the Environment of Nuclear Facilities (Off. Gaz. SFRY, No. 51/86) and was approved by the SNSA Decision No. 391-01/00-5-26546/MK on 10 November 2000.The surveillance measurements were carried out by JSI.

Programme is based on surveillance of activity, that are bounded on operation of research reactor at JSI and are not including measurements which are the surveillance of radioactive waste store at the same location.

3.4.1 SCOPE OF MONITORING

Measurements of releases from the source in order to enable assessment of the impact of the facilities:

- gaseous releases (aerosols and gases released from the exhaust from the reactor hall)
- releases of liquid effluents (radioactive isotopes in the discharge water from the Department of Environmental Science, and monitoring of some other liquids of the reactor systems, not released to the environment).

Measurements of radioactivity in the environment in order to assess the impact of the facility or to identify the impact from external polluters:

- air: radioactivity of aerosols at the control point.
- liquids: radioactivity of well water;
- external radiation: monitoring of dose rate with TL Dosimeters at four control points.
- radioactive contamination of soil;
- radioactive isotopes in the Sava river sediment.

An automatic meteorological station situated at the control point by the west fence of the centre provides meteorological data. Data are available on-line in the control room of the reactor. A novelty in 2001 was the continuous measurement of the dose rate with a Geiger-Mueller detector probe Berthold LB111 at the east control point. The data are promptly available in the control room of the reactor, and since August 2001 half-hourly sliding average values are stored on computer. The processing of stored data allows comparisons with the results from TL Dosimeters. Measurement of external radiation on the north side of the site represents a new control point of the surveillance programme.

3.4.2 MONITORING RESULTS

In 2001 no special events were observed in the reactor operation or other related activities, and the total produced thermal power was comparable to those in previous years (279 MWh). The releases of Ar-41 into the air (approx. 1 TBq in 2001) were directly correlated to the period of reactor operation and were also similar to the previous ones.

Measurements of external radiation on the ventilation shaft with TL dosimeters showed an increase for a factor of 2 compared to the background due to Ar-41 releases. Radionuclides Na-24, Co-60, Zn-65 were detected in the liquid effluents during the year 2001. The total released activity was 0.51 MBq resulting from the research work at the Department of Environmental Science and was the lowest in the last period.

Results of upper layer soil analysis showed no contamination with other artificial radionuclide beside Cs-137 from Chernobyl. The same is unchanged for the river Sava sediments downstream the discharge site. Results of radioactivity measurements in water well were under the detection levels, which were not quoted in the report. Data on aerosol radioactivity were not reported.

3.4.3 EXPOSURE OF THE POPULATION

The same methodology was used for exposure evaluation of the population as in the past. Only two exposure pathways were considered: external exposure due to Ar-41 immersion and ingestion of contaminated water. Due to lower releases compared with previous years the estimated annual effective doses to the population were exceptionally low.

There are no authorised dose limits for the operation of the research reactor thus the general limit for members of the public applies.

The external immersion dose due to releases of Ar-41 into the air was estimated at 0.25 microSv per year. The very conservative estimate of the ingestion dose (drinking of potentially contaminated river water due to the release of effluents into the Sava river) gives 0.02 microSv per year. Thus the total dose received by the public was estimated to be less than 0.03% of the annual dose limit to the population.

3.4.4 CONCLUSIONS

Monitoring of the environment of the Research Reactor at Brinje in the year 2001 was carried out according to the approved programme. On the basis of conservative presumptions, estimation was made of the radiological exposure for the member of the public due to the reactor operation. This was very low compared to the annual dose limit for the member of the public (1 mSv per year) and negligible compared to natural exposure in the normal environment (world average 2.4 mSv per year).

Source:

- Radioactivity monitoring in the environment of the Research Reactor Centre JSI – Report for the year 2001, JSI, no. JSI-DP-8586, Ljubljana, March 2002

3.5 RADIOACTIVITY MONITORING IN THE ENVIRONMENT OF THE CENTRAL RADIOACTIVE WASTE AT BRINJE

The radioactivity monitoring programme in the environment of the Central low and intermediate level radioactive waste storage at Brinje for the year 2001 was conceived in accordance with the Regulation on Radioactivity Monitoring in the Environment of Nuclear Facilities (Off. Gaz. SFRY, No. 51/86) and approved by the SNSA Decision No. 39102-2/2001/2RV/419 on 31 June 2001.

Measurements of radioactivity were carried out by the authorised technical support organisations, the Institute for Occupational Safety and the JSI.

3.5.1 SCOPE OF MONITORING

Measurements of radioactive releases at the source in order to enable impact assessment of the facilities:

- gaseous releases (radon and its progeny from the radioactive waste storage)
- releases of liquid effluents (radioactive isotopes in the common discharge water from the storage and the Dept. of Environmental Science of the JSI.
- external radiation on the external parts of the storage.

Measurements of radioactivity in the environment in order to assess the impact of the facility or to identify the impact from external polluters:

a) liquids: radioactivity of well water;
b) external radiation: monitoring of dose rate levels with TL Dosimeters at two control points;
c) radioactive contamination of soil near by the storage an storage exhaust vents;
d) radioactive isotopes in the Sava river sediment, upstream and downstream the release point.

Measurements linked to emergency preparedness comprised in-situ gamma spectrometry near the storage facility.

3.5.2 MONITORING RESULTS

The radioactive measurements performed in the year 2001 were entirely in compliance with the approved monitoring programme.

a) Emission measurements: The emission of Rn-222 was estimated to be 70 Bqs^{-1}. This amounts to a yearly release approximately of 2.2 GBq. In June 2001 the Agency for Radwaste Management carried out a project of processing and preparation of radium applications. After the performed repackaging the level of radon concentration in the storage decreased. Also the level of external radiation, especially at the P-0 ventricle, where primarily some of the radium applications were stored, was lowered. The highest measured concentration in the storage before June 2001 was 9200 Bqm^{-3}, while in the second half of the year the maximum value did not exceed 6600 Bqm^{-3}. The average concentration of Rn-222 in the storage was about 5000 Bqm^{-3}. Surveillance of liquid was introduced in monitoring programme in year 2001. During normal operation there were no liquid releases from the storage. External radiation measurements at the entrance to the storage showed 0.40 $microSvh^{-1}$, and the dose rates on the exhausts were 0.15 and 0.12 $microSvh^{-1}$. The storage underwent the reconstruction works (replacement of hydroisolations of the concrete). The levels of external radiation on the roof (at the left exhaust vent) were reduced from 2.5 $microSvh^{-1}$ to 0.6 $microSvh^{-1}$ due to additional protection shield.

b) Environmental radioactivity measurements: Additional radon concentration in the very vicinity of the storage was estimated based on the Gaussian dispersion model. Radioactivity measurements of the well water showed normal values of natural radionuclides and Cs-137, originated from the Chernobyl contamination and is not result from the storage operation. Soil samples in the vicinity do not show presence of any radionuclides apart from Cs-137 from Chernobyl, naturally occurring K-40 and uranium and thorium decay chains. The level of external radiation at a 10 m distance from the storage door was 0.12 $microSvh^{-1}$, and at a 30 m distance from the storage door 0.086 $microSvh^{-1}$ (natural background).

3.5.3 EXPOSURE OF THE POPULATION

As the critical group of population, the security officer of the JSI doing his rounds at the storage facility and the farmer doing his job in the nearby field were chosen. The annual effective dose was estimated based on radon progeny inhalation and direct exposure to radiation from the storage. There are no specific dose limits prescribed for the operation of the central radioactive storage by the competent authority, the limit for members of the public is applied. The total dose received by the member of the public (the above mentioned safety officer) is estimated to be 7.8 microSv/year, which is less than 0.8% of the annual dose limit. The annual dose at the fence of the reactor centre site, received by the neighbourhood farmer (under the same assumptions of staying there), would be around 0.03 % of limit value.

3.5.4 CONCLUSIONS

The monitoring programme of the environmental radioactivity monitoring in the vicinity of the Central radioactive storage facility at Brinje was not carried out completely in accordance with the current regulations and the decree of the SNSA. It was found that the effective dose received by the member of the public in the area affected by the storage facility was low that means negligible low burden on environment

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Source:

– Radioactivity monitoring at the Central LILW storage at Brinje – Report for the year 2001, ARAO, no. ARAO T1522-1/02, January 2002

3.6 RADIOACTIVITY MONITORING IN THE ENVIRONMENT OF THE ŽIROVSKI VRH MINE

3.6.1 MONITORING PROGRAMME

The regular environment monitoring program of environmental radioactivity has been running continuously for a decade and a half. It was established at the beginning of yellow cake production (1985). The program is based mainly on the US Regulatory Guide 4.14 (1980) and was approved by the competent regulatory authority. After cessation of mining and milling, during the current closedown period, the surveillance program has been running continuously and only some minor changes in the program scope have been made.

The programme covers all the critical pathways and therefore comprises radioactivity measurements in air, i.e. concentrations of long-lived natural radionuclides of the uranium-radium decay chain in aerosols, measurements of radon and its short-lived progeny outdoors, and radioactivity measurements of surface waters, sediments and water biota, food and fodder and in the soil, as well as measurements of external gamma radiation. The area of monitoring extends in particular to the valleys and other inhabited areas in the vicinity of the mine and milling facilities, mostly up to a distance of 3 km. The reference measurements are also performed at remote sites outside the mine impact area and, using these background data, the mine contribution to the radioactive contamination of the environment is estimated and exposure of the population is assessed.

In 2001, the monitoring was carried out by both technical support organisations for radiation protection, the IOS and the JSI, both from Ljubljana.

3.6.2 RESULTS

During the operational phase of the mine and mill at Žirovski vrh, radioactivity of the environment in the nearby vicinity was considerably higher than at more distant locations. In the present phase of mine closure, a decline in total emissions of radon and liquid effluents into the environment was observed, which has led to a partial decrease of radionuclide concentrations in individual media.

a)Air radioactivity

The difference in concentration levels was most noticeable in aerosols with long-lived radionuclides, which were determined by quarterly composite samples obtained by continuous sampling. Immediately after the cessation of ore exploitation these concentrations dropped almost to the normal environmental values. At the nearest villages (Todraž and Gorenja Dobrava) the levels of uranium in year 2001 decreased to 0.01-0.05 Bqm^{-3}. The measured concentration of Ra-226 in air show too high inconsistent values (on both tailing piles the executant measured out lower concentration than in distant valley settlement; concentration at Debelo brdo location should be higher then that in valley).

The results for Ra-222 in year 2001 showed that the increase in radon concentrations in the mine vicinity amounted of 5.1 Bqm^{-3} above the natural background, which is significantly less from the result (Gornja Dobrava) in last decade (7-9 Bqm^{-3}). The lower level of concentration is due to lower release of radon from cave in the previous years (working of cave ventilation, airprofe close of sap P-10 and because of conditional metaling of Jazbec mine waste).
In Table 3.9 the average results of continuos measurement of short-living radon concentrations on six measured locations in vicinity and two measured locations in narrow controlled area of the Žirovski vrh mine are presented. Results are given as equilibrium-equivalent radon concentrations (EEC) in Bqm^{-3}.

Table 3.9: Annual average equilibrium-equivalent radon concentrations (EEC) in the environment of the Žirovski vrh mine in the year 2001.

Location	Average EEC [Bqm^{-3}]	Min. EEC [Bqm^{-3}]	Max. EEC [Bqm^{-3}]
Surroundings of Žirovski vrh mine			
Gorenja Dobrava	15.9	<0.5	88
Todraž	15.7	<0.5	89
Todraž, pod trakom	18.2	0.5	99
Bacenski mlin	17	<0.5	99
Debelo Brdo	6.6	<0.5	84.5
Gorenja vas (ref.)	13.2	<0.5	94
Controlled area			
Boršt	14.3	<0.5	99.5
Jazbec	22.6	<0.5	> 100

b) Radioactivity of surface waters
In 2001, the radioactivity of surface waters shows the following: the concentration of U-238 in the Brebovščica was a little bit higher then in previous years (in year 2000 183 Bqm^{-3}), while the concentration of Ra-226 in the Brebovščica was 5.1 Bqm^{-3} (10.5 Bqm^{-3} in 2000) , and in the Todraščica 8.5 Bqm^{-3} (19.9 Bqm^{-3} in 2000). The concentration of Pb-210 increased from the previous year (from 22 Bqm^{-3} in 2000 to 33 Bqm^{-3} in 2001) in the Brebovščica, while in Todraščica it was similar to the one in the previous year (24 Bqm^{-3}). The average annual concentrations are shown in Table 3.10. The principal remaining sources of water pollution after the cessation of ore exploitation are the mine water and the drainage waters from the Jazbec mine waste deposit and the Boršt tailings pile. The discharge water with dissolved radioactivity from the Boršt tailings pile flows directly into the environment while the suspended matter is retained in the settlings pond. This is the main reason why radium concentrations in the Todraščica stream, in particular in the dry season, are significantly higher than those in the Brebovščica stream.

c)Sediments
In sediments, the content of the radionuclides in surface waters remained 2 to 4 times lower than in the operational period. The decrease in the contamination is supposed to be due to the

soil covering of the tailings at Boršt. The sediments in the Sora river downstream the confluence with the Brebovščica stream showed an increase of the mass specific activity up to a factor of 2 for a single radionuclide especially in the second and third quarter of year 2001.

Table 3.10: Average annual concentrations of uranium and Ra-226 in the Todraščica and the Brebovščica.

Year	Average annual concentrations of uranium [Bqm^{-3}]		Average annual concentrations of Ra-226 [Bqm^{-3}]	
	Todraščica	Brebovščica	Todraščica	Brebovščica
1996	128	170	38	20
1997	58	219	29	16
1998	37	188	13	5.6
1999	40	155	23	8.1
2000	38	157	20	10.5
2001	33	183	8.5	5.1

d)Food and fodder

The contents of the radionuclides Ra-226 and Pb-210 in fish contents in contaminated streams are higher than in the reference surface water). Radioactivity levels in agriculture products are generally low and show great fluctuations; sometimes they cannot be distinguished from those of the samples collected at non-contaminated reference locations. Some fodder samples (grass) were taken at the source of contamination (i.e. at the disposal area at Jazbec and Boršt) and not at the environment. For this reason there is no data of influence on environment.

High concentration of radionuclides in grass were detected at the disposal area at Jazbec and Boršt. Values of Ra-226 and Pb-210 are a class higher compared to the specimen from the reference location. Results from previous reports show that values in grass specimens are few times higher than at reference locations.

e)External radiation

After the cessation of ore exploitation, the external gamma radiation in the vicinity of the piles varied, depending on the character of remedial works such as formation and consolidation of pile surfaces, taking materials from other sites to a common pile, partial covering of surfaces etc. In external gamma radiation in the vicinity of the tailings pile at Boršt and at the Jazbec waste rock pile was significantly lower from the values at waste HMJ. Here it can be detected the higher radiation to the distance 200m from the edge of waste. With covering of the upper part of disposal area the radiation has dropped. The situation on P-1 and P-9 disposal has remained unchanged from 1992 (report JSI for 1992).

3.6.3 POPULATION EXPOSURE

The impact of the mine releases extends over an area inhabited by about 300 people. Most of the local adult population are either farmers and craftsmen or workers employed at more remote places. In the estimation of the effective dose to individuals from the reference group received from the former Žirovski vrh Uranium Mine sources, the following transfer pathways have been considered:

- Inhalation of long-lived radionuclides, of Rn-222 and its short-lived progeny;
- Ingestion (intake with food and water) through the water and soil food chain;
- External gamma radiation.

The dose conversion coefficients for the effective dose value estimation were taken from the IAEA BSS (1996) with one exception: the dose conversion factors for radon and its short-lived progeny were used according to ICRP 50 Publication (1988). The dose due to potential intake of water from the surface waters was also calculated, but it was not taken into account in the grand total, since the local population do not use this water for drinking, watering or irrigation. Table 3.11 shows the effective dose to the population in the vicinity of the Žirovski vrh Uranium Mine in 2001.

Table 3.11: Effective dose to the population in the vicinity of the Žirovski vrh Uranium Mine in 2001.

Transfer Pathway	Detailed Description, Major Radionuclides	Annual Effective Dose (microSv)
Inhalation	aerosols with long-lived radionuclides U, Ra-226, Pb-210 - Rn-222 (gas) - short-lived radon progeny	 3 4 164
Ingestion	- U, Ra-226, Pb210,Th-230 in drinking water (surface waters, underground water) - fish (Ra-226, Pb-210) - agricultural products and food (Ra-226 and Pb-210)	 (29) 0.6 <21
External radiation	- gamma radiation of Rn-222 and its progeny (deposition, immersion) - gamma radiation of long-lived radionuclides (aerosols) - direct gamma radiation (vicinity of tailings piles)	1.6 - 2
Total annual effective dose in 2001 (rounded)		0.23 mSv/year

The dose assessment was made for adult members of the public inside the broader critical group of population, receiving annually the highest additional exposure. These inhabitants live in the settlement Gorenja Dobrava, located 1.3 km north of the former uranium mining and milling facilities (report JSI 1990). The highest contribution to the estimated dose is due to inhalation of radon decay products.

3.6.4 CONCLUSIONS

The radioactivity measurements in the surroundings of the former uranium mine at Žirovski vrh showed that the cessation of uranium ore exploitation only partially reduced the impact of the radioactive sources, although the mine was closed almost ten years ago. No significant changes are expected until restoration of the disposal sites with radioactive waste residues is completed. Radon concentrations in the settled area in the surroundings of the mine have remained very similar to those of the operational period, although total radon emission decreased considerably. Radioactivity of surface waters slightly (Brebovščica) has increased (concentrations of U-238, Pb-210) compared to results of the previous year.

The annual radiation exposure of the nearby population from the presence of the former uranium mine and mill (0.23 mSv) in 2001 is lower to the values obtained for the last years of the operational period of the mine. Ra-222 sources remained the major sources of radioactive contamination of the environment; its decay products contribute at least ¾ of the additional exposure. All other pathways such as inhalation of long-lived radionuclides, the water pathway, and ingestion of local food and water contribute less than 0.07 mSv per year.

The effective dose for adults represents one third of the current annual dose limit of 1 mSv, prescribed by the national regulations (Off. Gaz SFRY, No.87) and by international recommendations (ICRP 90) and international BSS (IAEA, EU). Taking into account the total population exposure from natural radiation in this area (5.5 mSv), the former uranium mining at Žirovski vrh still represents about 4 % of this value.

Source:

– Annual report on Implementation of Radiological Protection and Environmental Impact of the Žirovski vrh Mine, report for year 2001 JSI-DP no.8560 March 2002

4 RADIOLOGICAL PROTECTION IN THE WORKING ENVIRONMENT AND IRRADIATION IN THE MEDICINE

4.1 THE REPORT BY THE HEALTH INSPECTORATE OF THE RS

4.1.1 INSPECTION OF NUCLEAR FACILITIES

The principal goal of the inspections performed was to ascertain the state of protection of workers against the risk from ionising radiation sources. The Health Inspectorate of the Republic of Slovenia (HIRS) surveys the nuclear facilities of the Krško Nuclear Power Plant (NPP), the Jožef Stefan Institute (JSI) with the TRIGA Reactor at Brinje, and the Storage for Intermediate and Low Level Radioactive Wastes at Brinje. HIRS carried out 6 inspections and 1 technical survey at the Krško NPP; two of these were performed jointly with the SNSA. At the JSI, the health inspector carried out 3 inspections (2 at Brinje and 1 at location Jamova 39); 1 inspection of the Reactor Infrastructure Centre was performed jointly with the SNSA. Two inspections were performed at ARAO (1 was performed jointly with the SNSA).

The inspections carried out at the Krško NPP included the following areas: radioactivity of the environment, training in radiological protection, import of nuclear fuel, outage works, construction of the entrance object and radiological report on outage. Surveillance of the NPP was more frequent before and during the outage works. From the viewpoint of radiological protection, the health inspector did not find any irregularities. The technical survey of the entrance object was carried out and two approvals were issued, for an applicability permit for the entrance object and the second for the construction of the outage complex following a decree of the Ministry of Environment and Spatial Planning. Four decrees were issued to ARSO for the permission of construction of earthquake observatories in the surroundings of the Krško NPP.

Inspections at the JSI – Reactor Infrastructure Centre at Brinje concerned the research reactor, hot cells and the general condition in the field of radiological protection. No deficiencies were detected. One inspection at the JSI concerned medical certificates, received doses and records on radioactive sources at the Department of Experimental Particle Physics. Some individuals did not have valid medical certificates, and the record of radioactive sources at this department was incomplete.

At ARAO, two extraordinary inspections were carried out in November of the hydro-insulation reconstruction at the Central Interim Storage for Radioactive Waste at Brinje. It was found that the workers of the external contractor did not enter the storage building during the construction work, that their health during the normal course of work was not threatened and that they had been informed of radiation hazard. With reference to radiation protection, a decree was issued already in October 2000, that ARAO must elaborate a program, have it approved by the Expert Commission for Nuclear Safety and implement it together with the authorised organisation. The ARAO filed a complaint against the decree to the Ministry of Health, which rejected the complaint. The ARAO then raised an administrative disagreement.

4.1.2 INSPECTION OF MINES AND OTHER FACILITIES WITH RADON SOURCES

HIRS, together with the authorised organisations, regularly surveys the Žirovski vrh Mine in Decommissioning (ŽVM), and periodically the Mežica Lead and Zinc Mine in

Decommissioning (MLZM), the Cave of Postojna, Turizem, d.o.o., and other facilities with increased levels of radon and its decay products.

At the ŽVM, three inspections and one technical survey were carried out, concerning control of radioactivity in the environment, records and storage of ionisation fire detectors, deposition of mine and hydrometalurgical tailings on the tailing piles and the mine, cave ventilation and measurements of radioactivity in the cave and remedial works on the processing plant and the area where facilities had been pulled down. No deficiencies were detected. Apart from radon releases from the tailing piles, no major radiological problems were noted at the Žirovski vrh Mine. A decree was issued for monitoring radiation in the environment. A technical survey was carried out in the P-10 gallery, renovated for their needs by the Ministry of Defence. Permission was obtained for the construction of workshops for the production process specified by the Ministry of Defence.

The decommissioning works in the Mežica Lead and Zinc Mine (MLZM) are almost completed, but the requirements specified in the HIRS decree from 1995 are still being implemented. One inspection was carried out in the year 2001, on the program of radiation survey in the working environment, the dosimetric report and medical examinations.

The Cave of Postojna, Turizem d.d. was monitored for the exposure of guides and other workers in the cave to the radon progeny in the air. The radiological measurements were carried out by the JSI and the medical examinations by the IOS.

Concerning radon exposure of employees, inspections were carried out in the kindergartens in Idrija, Jesenice and at ŽVM. A decree was issued to the kindergarten in Idrija requiring reconstruction of the building on Arkova Street, because the effective doses which the children and employees had received were over 5mSv. A decree was also issued to extend the deadline for the reconstruction at the elementary school in Dvor near Žužemberk.

Addressing the radon problem in schools and kindergartens, the HIRS provided funds for a program of radon measurements in 26 schools and in 17 kindergartens. The JSI continued in the 2001 with radon measurements in the most critical buildings, where radon concentrations in the previous period of measurements (1990-1998) exceeded 400 Bq/m^3. The results of these measurements mostly confirmed the initial results. The average levels were even higher than 1000 Bq/m^3 in some rooms in five of these schools. The additional program includes measurements of radon concentration in the air and water, as well as radium measurements in water at 10 different water supply companies. The radiation doses of workers in 6 companies were low (below 1 mSv), while in the companies in Grosuplje, Ilirska Bistrica, Postojna and Sežana they were above 1 mSv, which requires further examination.

4.1.3 INSPECTIONS IN MEDICAL INSTITUTIONS

4.1.3.1 X-ray devices in human and veterinary medicine

In the year 2001, HIRS paid most attention to establishing the current state concerning the usage of various ionising radiation sources in medicine. The main focus was on:

- the establishment of records of X-ray devices and periodical annual examinations of their quality,
- the prescription of procedures for the implementation of protection against ionising radiation in the framework of good work practice, and
- the problems arising in the purchase of X-ray devices and acquisition of usage licences.

According to the records of HIRS, there were 696 X-ray devices in use in Slovenia in human and veterinary medicine at the end of the year 2001. The distribution of the devices with regard to their intended purpose is presented in Table 4.1.

Table 4.1: Number of X-ray devices in human and veterinary medicine by purpose.

PURPOSE	Status in 2000	New	Written-off	Status in 2001
DENTAL	340	24	17	347
DIAGNOSTIC	258	17	18	257
THERAPEUTIC	4	0	0	4
SIMULATOR	2	0	0	2
MAMMOGRAPHS	29	1	0	30
COMPUTER TOMOGRAPH CT	15	1	1	15
DENSITOMETRES	15	3	1	17
VETERINARY	21	3	0	24
TOTAL	684	49	37	696

In 250 private medical organisations 285 X-ray devices were in use, and 411 were used in 107 public health organisations. A more precise distribution of X-ray devices with regard to their ownership is illustrated in Table 4.2.

Table 4.2: Number of X-ray devices in human and veterinary medicine with respect to their ownership (Number of devices in the year 2000/Number in the year 2001).

PURPOSE	Private out-patient clinics	Hospitals	Public health institutions	Total
DENTAL	233/232	4/4	110/104	347/340
DIAGNOSTIC	18/21	183/184	56/53	257/258
THERAPEUTIC	0/0	4/4	0/0	4/4
SIMULATOR	0/0	2/2	0/0	2/2
MAMMOGRAPHS	10/10	14/14	6/5	30/29
COMPUTER TOMOGRAPH CT	2/2	13/13	0/0	15/15
DENSITOMETRES	12/10	5/5	0	15/15
VETERINARY	10/7	0	14/14	24/21
TOTAL	285/282	225/226	186/176	696/684

In the year 2001, the HIRS issued 57 usage licenses for work with X-ray devices and 2 for work with an accelerator. 5 inspections were carried out. On the basis of the findings of the inspections, two decisions were issued: one prohibiting the use of an X-ray device (Orthopaedic Clinic of the University Medical Centre) and one requiring introduction of personal dosimetry and education on protection against ionising radiation. Three approvals of usage licences were issued (Neurological Clinic of the University Medical Centre, Paediatric Clinic of the University Medical Centre and the Institute of Oncology).

Technical inspection of X-ray devices in medicine is carried out by the authorised organisation, the Institute of Occupational Safety (IOS) as described in Chapter 4.3.2. The condition of the radiological equipment is shown in the Table 4.3.

Table 4.3: Condition of diagnostic X-ray devices in the last five years.

Condition of diagnostic X-ray devices in the last five years	1997	1998	1999	2000	2001
In perfect order	169	235	210	221	209
Service needed	74	16	67	64	45
Proposal to write off	40	15	39	33	30
Written off	16	31	18	16	16
New	31	28	22	11	19
Out of order	6	6	3	8	16
TOTAL	336	324	359	353	335

In the year 2001, the veterinary X-ray devices were not taken into account

4.1.3.2 Unsealed radiation sources in medicine and in other laboratories, and sealed radiation sources in medicine

Seven clinics or hospitals in Slovenia use unsealed radiation sources (radiopharmaceuticals) for diagnostics and therapy. These are: the Medical Centre Ljubljana – the Department of Nuclear Medicine (DNM), the Institute of Oncology and the general hospitals in Celje, Maribor, Slovenj Gradec, Šempeter near Gorica and Izola. The control at the Institute of Oncology includes both unsealed and sealed radiation sources (the latter are 2 high-activity radiation sources with Co-60, 1 with Ir-123, 3 with Sr-90 and 25 with Cs-137, and 3 accelerators) at the departments of teleradiotherapy and brachyradiotherapy. Small amounts of sealed radiation sources in medicine are also located at the University Medical Centre in Ljubljana.

In the year 2001, the health inspector carried out two inspections in these facilities. One inspection was carried out at the Institute of Oncology, and no deficiencies were observed. Twice per year reviews by the IOS are carried out in hospitals in Celje, Maribor and Šempeter pri Gorici, where no major deficiencies were observed in 2001. An inspection was performed only in the hospital in Celje, where minor shortcomings were found (calibrations of radiation measuring devices were not valid, the sanitary control point was not optimal, accident emergency procedures were not displayed in public spots). In spite of a decree issued in 1995, DNM still has not constructed a special closed system for the retention of liquid radioactive effluents. DNM laboratories are checked by JSI twice per year.

4.1.3.3 Exposure of population to doses from use of radiation sources in medicine

The activity of the European Commission in the area of protection against ionising radiation is based on the contents of the EURATOM Treaty, which imposes establishment of basic safety standards intended for protection against harmful impacts of ionising radiation. Due to the specific nature of health protection of individuals exposed to ionising radiation in medical use, the safety standards from this field are laid down in a separate Directive 97/43/EURATOM, also called the Medical Exposure Directive (MED); in which the instructions from the publication International Commission on Radiological Protection (ICRP) 73 are summarised.

Diagnostic radiology represents by far the greatest contribution to radiological exposure of the population due to artificial ionising radiation sources. Approximately 15 % of the total dose received by an average European results from the medical use of ionising radiation. With the exception of natural radiation sources, almost 90 % of the collective dose is the result of radiological diagnostics.

In 2001 HIRS therefore provided funds for a pilot project the purpose of which was to incorporate patient personal dosimetry into various radiological examinations. A research study was carried out by IOS, entitled ‘Exposure of patients to radiation at the General Hospital of Maribor due to standard X-ray examinations’. The results are described in Chapter 4.3.5. In this way, HIRS would like to make its contribution to the establishment of uniform criteria for quality assessment of radiological examinations, which also includes assessment of diagnostic reference levels at the national level. Diagnostic reference levels are one of the criteria for an objective comparison of different diagnostic procedures, reflecting the state in a country and permitting the development of optimisation procedures. The activity of HIRS surpasses in its contents a merely formal compliance with the European Community legislation and is intended primarily to improve the quality of radiological services in Slovenia, and to contribute to the well-being of all patients and other examined persons.

4.1.4 INSPECTIONS IN INDUSTRY

4.1.4.1 Sealed radiation sources and X-ray devices in industry and elsewhere

HIRS also surveys users of sealed radiation sources in industrial plants and elsewhere according to the Regulation Z4.

For the year 2001, a total of 99 work organisations or units were recorded, in which 577 sealed radiation sources were used for the control of work processes, and 19 other organisations or laboratories which mostly had low-level radiation sources used in education, research or testing of measuring devices. Separately recorded are ionising fire detectors (total number - 49.320), industrial X-ray devices (total number - 103) and 1 accelerator Tandetron at JSI for research purposes. All the sources are checked at least once per year according to the valid regulations by one of the authorised organisation (IOS or JSI).

In industrial plants, 12 inspections were carried out in 2001, concerning the use and storage of radioactive substances (Goodyear EPE Kranj, Sava d.d. Kranj, Sava Tires Kranj - twice, Acroni Jesenice, Mascom Lenart - PE Maribor, M&K Dornava - PE Maribor, Impol Slovenska Bistrica, AMI/ALUSIL Kidričevo, IRGO Ljubljana, Motel Grosuplje, Metalna Maribor and IMK Ljubljana). The inspection surveys at Goodyear EPE, Sava d.d. and Sava Kranj were needed because responsibilities with regard to storage of the sources had not been defined and because of the high dose received by a maintenance worker. Detailed examinations were carried out also in other companies to determine the ownership of several unusable sources, on the quality of their records of sources and on proper source storage. An examination at Motel Grosuplje was carried out, following an intervention of the Ecological Laboratory with a Mobile Unit. It was discovered that an unnecessary additional dose had been received by the workers during an unprofessional removal of a radioactive source (a lightning conductor) and its transport to the Storage for Intermediate and Low Level Radioactive Wastes at Brinje. An inspection was also carried out at IMP, d.o.o. due to an unexplained high dose (but still below the allowed limit) received by the workers.

For the recording and delivery of disused sources two decrees were issued to the ironworks Acroni d.o.o. and Železarna d.o.o. Jesenice, and an extension of deadline for the same was issued to the Biotechnical Faculty. A third decree was issued to Motel Grosuplje requiring determination of the person responsible for radiation protection, expert examination of the radioactive lightning conductor, and a report on the intervention by the authorised organisation and the medical examination of the exposed workers.

24 additional licenses were issued for the purchase and usage of sealed radiation sources.

4.1.4.2 Transport of radioactive materials

The records of road transporters who in 2001 complied with the prescribed conditions for the transport of radioactive substances are no longer kept by HIRS because according to the new Act on Transport of Dangerous Goods (Official Journal of RS, No. 79/99) transporters do not need to apply for licenses any more if they satisfy the ADR requirements. Furthermore, The Ministry of Health is responsible only for radiopharmaceuticals, while issuance of other licenses is the responsibility of the SNSA.

An intervention inspection was carried out at the company Odpad Velika Pristava near Pivka because a radioactive source was discovered in scrap iron in a wagon, sent back from the Italian frontier post in Gorica. A detailed description of the intervention is presented in Chapter 5.6. The Ecological Laboratory with a Mobile Unit transported the radioactive source to the Central Interim Storage for Radioactive Waste at Brinje. Two other inspections were carried out in December in the company Surovina, d.d. (Maribor, Ravne) of a wagon of scrap iron from the ironworks Ravne, which had also been sent back from an Italian frontier post.

In the year 2001, HIRS issued 8 licences for transport of radiopharmaceuticals (7 for imports and 1 for transit) and 1 approval of licences for transport of other radioactive substances, issued by the SNSA to the Biotechnical Faculty of the University of Ljubljana.

4.1.4.3 Radiochemical and other laboratories

These laboratories use unsealed radiation sources with activities which are generally around a thousand times lower than in hospital wards, so the potential danger is low. In the year 2001 a technical examination of a newly built radiochemical laboratory at the company Lek, d.d. Mengeš was carried out. Laboratories are checked once per year by the authorised organisation (JSI or IOS), and in 2001 only some minor irregularities were observed.

4.1.4.4 Education and training

The professional qualifications of the persons working with ionising radiation sources are mostly in accordance with the Regulation on professional qualification, medical conditions and medical examinations of persons working with the ionising radiation sources. Training, advanced training and competence exams are carried out by two authorised organisations (JSI and IOS). Individual institutions and organisations may perform refresher courses for their workers, either themselves or in co-operation with authorised organisations.

The inspectors carrying out inspections of ionising radiation sources also give lectures on the legislation in the field of radiation protection. In the year 2001, training programs were carried out at IOS, JSI (ICJT), NEK-ICJT, and also at the University Medical Centre Ljubljana and at the general hospitals of Trbovlje and Slovenj Gradec. The inspectors follow special training programs in the field of radiation protection. In the year 2001 they also participated in several training courses and conferences in Slovenia and abroad, in the fields of radiation protection, medical physics, IAEA Directives on administrative control, etc.

4.1.4.5 Medical examinations

Some irregularities were observed concerning irregular participation in medical examinations. The reports on medical examinations are given in Chapter 4.7.

4.1.4.6 Legalisation in the field of ionising radiation

In the year 2001 an expert group of representatives of the Ministry of Environment and Spatial Planning and the Ministry of Health was set up, which prepared a proposal for the Act on Protection against Ionising Radiation and Nuclear Safety. The proposed act also specifies the deadlines for the preparation of individual regulations, which must be in accordance with the EU Directives. The Ministry of Health is responsible for the field of ionising radiation protection of exposed workers and the public, defined in the following Directives:

- council directive laying down basic safety standards for the health protection of the general public and workers against the danger of ionising radiation (96/29/EURATOM)
- council directive on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas (90/641/EURATOM)

- council directive on health protection of individuals against the dangers of ionising radiation in relation to the medical exposure (97/43/EURATOM).

4.1.5 CONCLUSION

In the year 2001, the emphasis was on preparation of new legislation on ionising radiation protection.

Due to the very intensive activity on legislation preparation, fewer inspections were performed in the field of protection of the population and the environment against ionising radiation compared to the year before. There was also less activity relating to the surveillance of the facilities with increased radon level. Control of transportation of radioactive substances also decreased, due to the new legislation according to which the SNSA was given the competence of issuing transport licences. HIRS estimates, however, that the radiation protection was sufficient, since the control was performed regularly by the authorised organisations, with regard both to the different activities and different radiation sources. In the year 2001, the work on two projects continued, i.e. the project entitled “The measurements of radon in schools and kindergartens”, which is the basis for further measures in the case of higher radiation exposures of children and employees, and the pilot project: “Radiation exposure of patients in the General hospital of Maribor due to standard X-ray examinations”, which should contribute to improved quality and safety of radiation services in the Slovenia.

4.2 COMPUTERISED REGISTRATION SYSTEM OF OCCUPATIONAL EXPOSURE IN THE NUCLEAR FUEL CYCLE IN SLOVENIA

4.2.1 INTRODUCTION

In the year 1999 the SNSA started to develop a computerised registration system of occupational radiation exposure for workers in the nuclear fuel cycle (NFC) in Slovenia. The Register includes data of about 5500 persons, among them data of approximately 1200 workers that are employed (or were employed) in facilities at the NFC in Slovenia and about 4300 outside workers that are (or were) engaged mostly in maintenance work at the NPP.

The legal basis for the introduction of the Register of received doses is the valid legislation of the Republic of Slovenia: the Act on Radiation Protection and Safe Use of Nuclear Energy (Off. Gaz. SFRY No. 40/86) art. 65, the Regulation on Records of Ionising Radiation Sources and on Exposures of Population and Workers (Off. Gaz. SFRY No. 40/86) art. 4, and the Act on competencies and working areas of ministries (Off. Gaz. RS No. 71/94). The SNSA established the Register in accordance with the requirements from the EU directives – 96/29/EURATOM 90/641/EURATOM.

The LOTUS NOTES / DOMINO and JAVA are used as a basic software. Its advantage is the possibility to receive the data on occupational exposure in the original electronic form from all files which are available at the dosimetric services of the NPP, ŽVM, JSI and IOS.

4.2.2 THE DATA IN THE NFC DOSE REGISTER

The register is the fundamental data collection of received doses, personal data of the workers, and facilities data in the nuclear fuel cycle. Included in the NFC Register are the workers in the facilities in the nuclear fuel cycle in Slovenia (the NPP, the research reactor at Brinje (Ljubljana) and the Central storage facility for low and intermediate level radioactive waste at Brinje), and also in administrative organisations (the SNSA and the ARAO).

The Register includes three types of data:

1. Data on received doses, which include the monthly dose, the quarterly dose, the dose received in the last twelve months and the lifetime dose.
2. Personal data of workers, which include the identification number, first and last name, sex, date of birth, education, the date of beginning of work with ionising radiation, specification of whether the worker is an employee or a contractor, the facility where the dose is (was) received, job classification, the employer, data on medical examination and the certificate of the radiation protection exam. The data on external (gamma, neutrons) and internal exposure are recorded separately. There is a possibility to insert into the register data on the type of dosimeter(s) and previous data on received doses, archived in paper documents.
3. Data on facilities, which include the name of the facility, address, zip code, town, country, telephone number, fax number, e-mail, and the method of transferring data to the Register.

4.2.3 LOOKING THROUGH THE DATA IN THE NFC DOSE REGISTER

The recorded dosimetric data (individual and collective doses) have been statistically evaluated by a software system and different written reports on received doses have been prepared.

a) Statistical review of individual received doses

The statistical review of the stored data makes it possible to examine the whole history of occupational exposure of any individual worker in terms of place and time, i.e. (a) by workplaces and (b) by individual years. At the end of the 2001 only the data existing in the electronic form were provided by the dosimetric services to the NFC Register. This means that the data from the Krško NPP have been available annually since 1985 to 1998 and monthly from 1999 to 2001, from the Uranium Mine and Mill annually since 1995 to 1999, from the Research Reactor at JSI monthly since 1988, from the SNSA quarterly since 1991, and the data on received doses for workers from the Agency for Radioactive Waste, working at the interim storage for radwaste at Brinje and Zavratec, monthly since June 1999.

b) Statistical review of collective doses of workers, sorted by employers

The statistical review of collective doses from the register makes possible immediate insight into the cumulative collective effective dose, annual collective effective doses for different occupations or activities, by separate employers and by individual years or workplaces. The collected data was also presented at the Regional Congress on Radiation Protection in Central Europe in Dubrovnik (May 2001), with a paper entitled The Computerised Registration System on Occupational Exposure in Nuclear Fuel Cycle in Slovenia.

4.2.4 WRITTEN REPORTS

The dose register makes it possible to prepare different written reports on the data from the register. Currently, three important types of written reports are available in addition to the graphical presentation of the data:

a) Report on received doses for an individual

The report contains personal data and the whole history of the worker′s exposure. This report is requested for the purpose of getting permission for work in an controlled area and should be submitted prior the medical examination to the approved occupational health service. Data about the received dose in a certain period and the cumulative dose of the worker, together with personal data, are also included.

b) Statistical report on received effective doses of workers in each facility

The statistical report on received effective doses includes the annual distributions of effective doses in dose intervals for the whole period of operation of the facility.

c) Special statistical report of the SNSA on received doses

The special statistical report of the SNSA on received doses is a general statistical view on received doses which comprises the cumulative collective and the average doses in the NFC facilities.

d) Graphical presentation of data

The software used makes it possible to present the data on received dose graphically, i.e. in tables and figures, according to the needs and interests of the user. The graphs, however, can only be seen if the textual data are exported to Excel.

4.2.5 PROTECTION OF PERSONAL DATA

The protection of personal data is ensured by the software which was elaborated in accordance with the Act on Protection of Personal Data (Off. Gaz. RS 8/90 and 19/91). Access to the NFC Register is only given to the authorised personnel at the SNSA. The authorised administrator and the authorised radiation protection officer of the application have access to all data in the database system and to all applications of the NFC Register.

4.2.6 CONCLUSIONS

Introduction of the NFC Register at the SNSA makes it possible for the regulatory body to supervise all data on individual and collective exposures, according to the EU directive mentioned above.

In the future, considerable efforts will be needed to get the data encompassing the whole history of occupational exposure in the nuclear fuel cycle in Slovenia. A large part of the data is still archived only in paper form and should be put into the register manually. With the data included into the Register it is possible to prepare a Personal Dosimetric Document for each worker or contractors. Personal data and the whole history of a worker′s exposure are included in such a document.

The dosimetric data in the NFC Register are organised in a way that enables easy access to any information. NFC Register applications should be open (allowing access via the Internet, but with password protection) to the approved outside users under special conditions. This project also allows fast transfer of dosimetric data requested or needed by various international organisations.

4.3 REPORT OF THE INSTITUTE OF OCCUPATIONAL SAFETY (IOS)

In the year 2001, the Radiation protection department of the IOS performed supervision of implementation of occupational radiation protection and control of radioactive contamination of the living environment within its authorisation. The part of the report which concerns medical examinations is given in Chapter 4.7.3.

Supervision of practices involving the use of ionising radiation includes regular professional control of ionising radiation sources and of the procedures for their usage, monitoring of radiation at workplaces and personal dosimetry. In the medical field, this supervision also includes protection of patients from radiation by quality checks of radiological equipment, with an emphasis on suitability of equipment for its purpose. Monitoring of exposure of patients during medical interventions by using ionising radiation is carried out within a research project ‘Exposure of patients due to classical radiological examinations’, undertaken at the General hospital Maribor (number of the report: CVS DP-10009/01), and financed by the HIRS within the budget of the Ministry of Health, and also in the framework of the research project ‘Determination of patients’ exposures due to X-ray examinations in Slovenia’. The latter project was financed by the Institute of Health Insurance of Slovenia; the number of the report (finished in the year 2002) is CVS DP-1001/02.

Monitoring of radioactive contamination in the living environment was performed by the Radiation protection department in the frame of the following programmes:

- monitoring of global radioactive contamination in the environment within the programme of Regulation Z -1
- radiation monitoring in the environment of the Krško NPP
- radiation monitoring in the environment of the Žirovski vrh Uranium mine

In addition, the IOS performed measurements of radon and radon progenies concentrations in dwellings and in the vicinity of the former coal mine in Kočevje. Measurements of radon and radon progenies concentrations were also performed in the caves of Škocjan.

4.3.1 RADIATION PROTECTION IN THE WORKING ENVIRONMENT

As part of the regular supervision of ionising radiation sources used in medicine and industry, IOS performed 988 inspections in 2001, which is 70 more than the year before. The total number of sources in the register is not equal to the number of inspections carried out in one year, because some of the sources were not in use at the time, and some were inspected several times due to major changes (services and replacements of essential parts).

All reports on inspections are sent to the user and to the HIRS, which performs administrative and inspection control of the application of protection against ionising radiation.

4.3.2 MEDICINE

In 2001, 680 inspections of ionising radiation sources were performed in medicine, compared to 651 inspections in the previous year. Table 4.4 shows the types of inspected sources and the number of corresponding inspections.

Table 4.4: Number of inspections of ionising radiation sources.

1. DIAGNOSTIC RADIOLOGY EQUIPMENT	
X-ray conventional units for imaging	128
X-ray units for imaging and/or diascopy	91
Mobile x-ray equipment for imaging or diascopy in patient rooms or operation rooms	32
Mammography X-ray machines	25
Computer tomography	14
Bone densitometry	15
2. DENTAL RADIOGRAPHY	
Conventional X- rays	225
Dental tomography	45
3. RADIOTHERAPY	
X-ray machines for therapy simulation	2
Therapeutic X-ray machines	3
4. NUCLEAR MEDICINE and RESEARCH LABORATORIES	
Isotopic laboratories using open ionising radiation sources	20

In addition to this, also 19 X-ray machines used in veterinary medicine were inspected.

Supervision of ionising sources in medicine includes supervising the occupational safety of workers and all other persons who could come into a radiation field. During regular inspections of radiological equipment, all the parameters affecting patient exposure are checked, as well as those relating to the quality of the results of medical examinations (mainly with regard to the quality of radiographic images). In doing this, the European criteria are generally followed (the European Commission Criteria for Acceptability of Radiological (including Radiotherapy) and Nuclear Medicine Installations, European Commission, Radiation Protection 91, Luxembourg, 1997), as the current national legislation is obsolete and the regulations criteria are often useless.

Regarding the quality of separate types, radiological equipment is classified into several classes, i.e. equipment:

- in operation, without any defects
- service needed
- proposed for write-off
- written-off in the current year
- new equipment
- currently not in use or out of order

This categorisation with separate classes which represents the status of radiological equipment in medicine and dental service is shown graphically in Figures 4.1., 4.2., and 4.3. A comparison of the status of X-ray diagnostic devices in 1997-2001 is presented in Figure 4.1. The status of X-ray diagnostic devices is given in Figure 4.2. and that of dental X-ray devices in Figure 4.3.

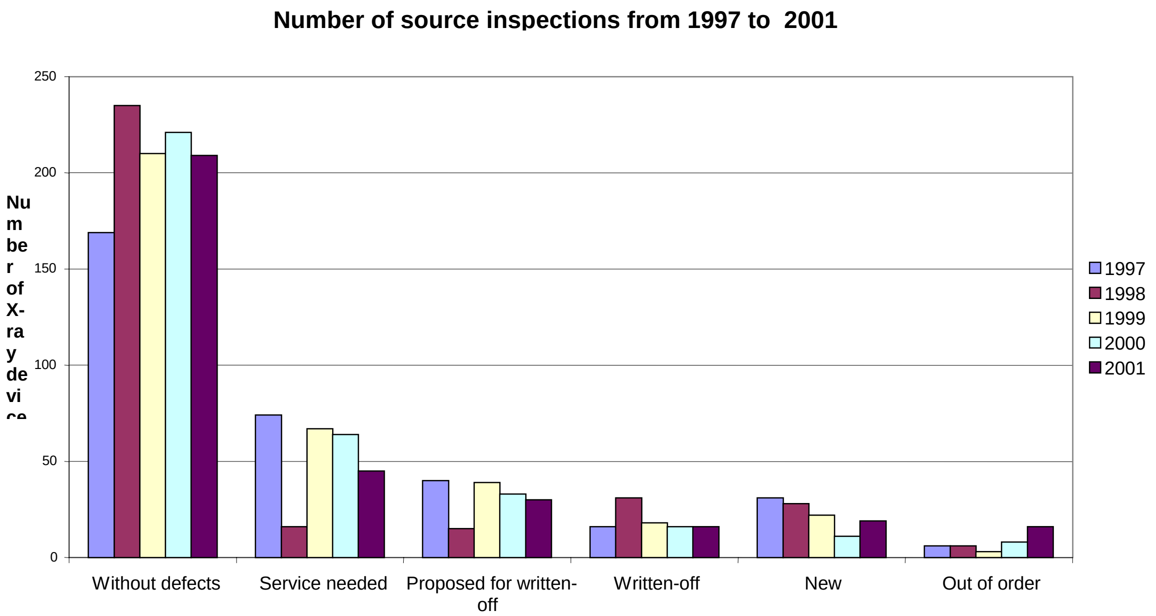

Figure 4.1 Number of source inspections from 1997 to 2001.

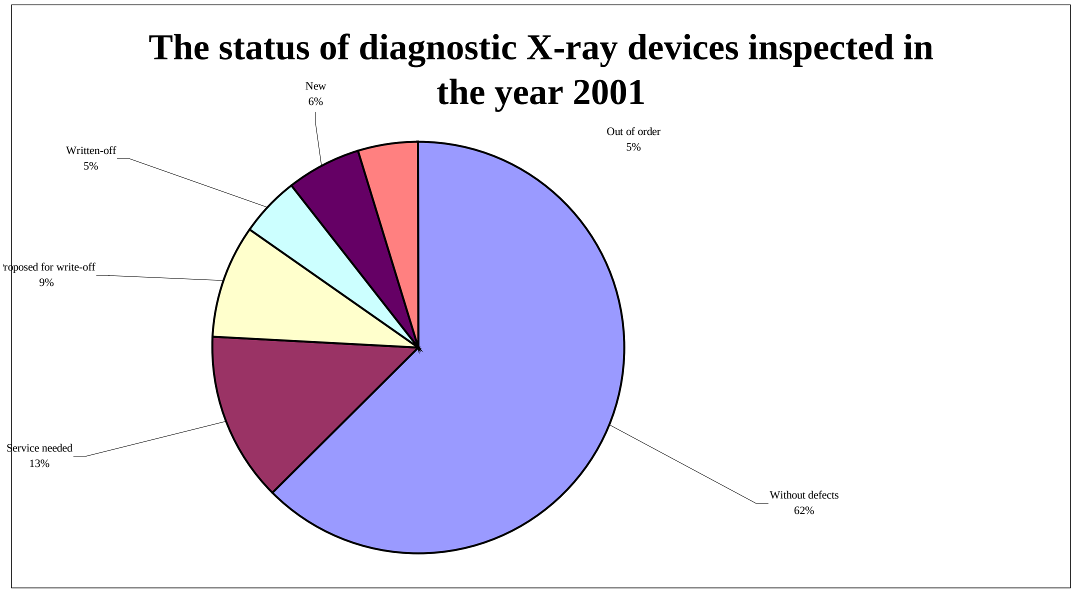

Figure 4.2. The status of diagnostic X-ray devices, inspected in the year 2001.

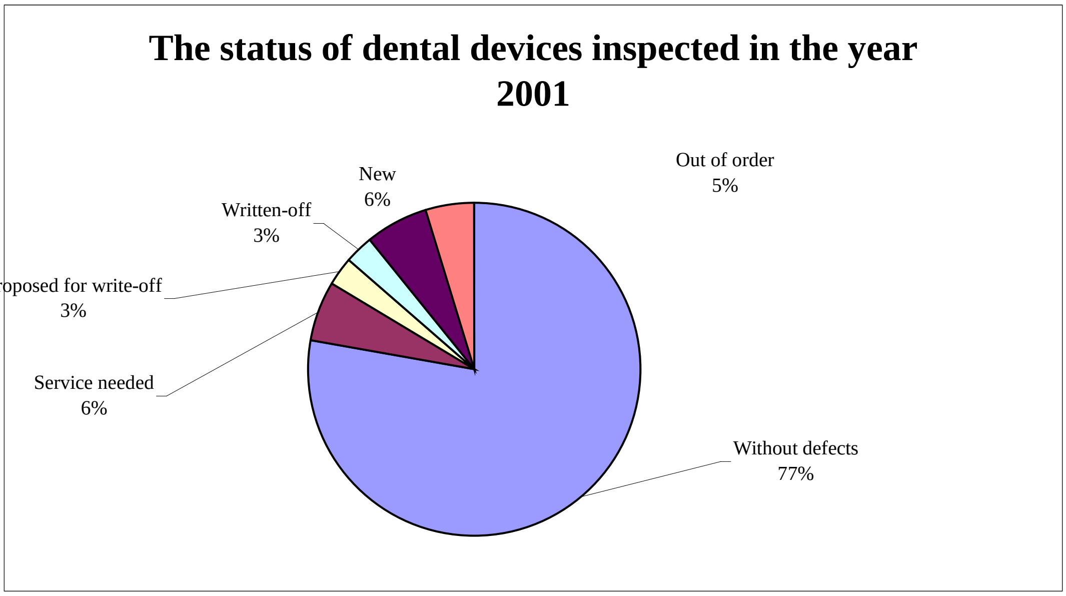

Figure 4.3. The status of dental devices inspected in the year 2001.

4.3.3 INDUSTRY

In 2001, altogether 284 different radiation sources were examined in industry, while in 2000 the number of these was 246. Table 4.5 presents the number of checked sources by separate types.

Table 4.5: Number of sources inspected, by types .

INDUSTRY	
Industrial X-rays	66
Defectoscope	13
Static electricity eliminator	2

Quantometers	15
Thickness gauges	11
Level gauges	68
Lightning rods	53
Density gauges	46
Density and humidity probes	46

4.3.4 EXPOSURE AT WORKPLACES

In 2001, exposures of altogether 3118 persons, employed in 648 organisations were controlled by dosimetric service of the IOS; in the year 2000, 2886 persons in 630 organisations were controlled. Dose statistics by separate fields of work and dose intervals are presented in two forms. In the first form, doses below the reporting limit (0.04 mSv per month) are included, while in the second one these values are considered to be 0 mSv.

Reports on measured doses are sent to users and to the HIRS, and for the ARAO workers also to the SNSA. The reports are sent to users in written form and to the HIRS in electronic form, in order to allow filling the data into the central national dose register which was introduced in 2000. All doses in 2001 were below the regulatory limit of 50 mSv.

In order to provide good quality of dosimetric services, the IOS took part in an intercomparison in 2001, namely the intercomparison of personal dosimeters organised by the National laboratory of dosimetry standards at the JSI .

Apart from taking part in intercomparisons IOS is constantly checking the quality of its dosimetric service in the following ways:

- Monthly checking of IOS dosimeters in co-operation with the laboratory for secondary dosimetric standards (LSDS) at JSI. 10 dosimeters are irradiated with unknown dose in order to establish the tolerance value region.
- Thorough yearly check of the dosimetry service in co-operation with LSDS in order to define the scattering of results and the deviation from true value
- IOS daily checks on dosimeters and eliminates defective ones
- By irradiating dosimeters with its own Cs-137 source once every 3 years. IOS checks all dosimeters by exposing 5 reference dosimeters to radiation levels between 1 and 2 mSv. In this way, IOS defines the mean value of readings, standard deviation and scattering of the results.

4.3.5 EXPOSURE OF THE PATIENT

In 2001 HIRS funded a pilot research project for the determination of patient exposure levels during the common X-ray examinations. The project was performed in co-operation with the General Hospital Maribor and the National laboratory of dosimetry standards at JSI. In the Table 4.6, the results of entrance surface dose (ESD) measurements (median of measured values) are compared with the reference diagnostic levels recommended by the European Commission Guidance on diagnostic reference levels (DRLs) for medical exposures (Radiation Protection 109, Luxembourg, 1999). In cases where values are missing, the IAEA recommendations (International Basic Safety Standards for Protection against Ionising Radiation and for the Safety of Radiation Sources, Safety Series No. 115-I, Vienna 1994) were followed. The last column gives the data on entrance surface doses measured within the research work “Population exposure due to medical use of ionising radiation in the Republic of Slovenia”, which was performed during the years 1992 and 1996 by IOS.

Table 4.6: Entrance surface doses (ESD) and their comparison with the recommended diagnostic reference levels.

Examination	ESD [mGy]	Reference level [mGy]	ESD_{1996} [mGy]
PC / PA	0.23	0.3	0.23
PC / LAT	0.67	1.5	0.84
LSH / AP	5.33	10	4.57
LSH / LAT	10.99	30	10.16
LSJ / LAT	11.62	40	15.30
TH/AP	4.19	3.5	3.70
TH/LAT	6.54	10	6.57
Skull PA	-	5	1.16
Skull LAT	-	3	1.17
Abdomen AP	3.53	5	2.78
Pelvis AP	4.26	10	3.42
CH / AP	-	-	1.37

The pilot project was designed as the first phase of a potential introduction of patient dosimetry as regular practice, on the basis of this research work results and gained experiences. This is also a requirement of the latest European legislation on radiation protection (European Union Council Directive 97/43/Euratom on Health Protection of Individuals against the Dangers of Ionising Radiation in Relation to Medical Exposure, Official Journal of the European Communities No. L180/22 – 29.9.07.97, 1997).

4.3.6 TRAINING FOR SAFE WORK WITH IONISING RADIATION SOURCES

In 2001 IOS organised several seminars on training for safe work with ionising radiation sources. Table 4.7 presents the number of trainees by fields of work.

Table 4.7: Training for safe work with ionising radiation sources.

SEMINAR for	Number of participants in 2000	Number of participants in 2001
Radiologists (medical doctors)	41	17
Dentists	112	41
work with open sources	44	17
Radiologists (radiological engineers)	138	53
work in industry	135	99
Occasionally exposed	487	332
work in uranium mine	8	1
Postgraduate students of Faculty of biology	11	4
Krško NPP personnel	11	0
Radiation protection officers	12	9
Workers of Institute of Oncology	126	0
TOTAL	1125	573

4.3.7 INSPECTION OF RADIATION SOURCES AND DOSES RECEIVED

Tables 4.8., 4.9. and 4.10. present the occupational exposure in Slovenia.

The meanings of the abbreviations:

DR Diagnostic radiology

ZR Stomatology – dental X-ray
NM Nuclear Medicine
I Industry
VET Veterinary Medicine
O Other
TR Radiotherapy

Table 4.8: Doses received in the practice.

Code of practice	Number of workers	Collective dose [manmSv]*	Average dose [mSv]*	Practice [UNSCEAR code]
DR	1866	998.3	0.54	Diagnostic radiology(2000)
ZR	313	143.1	0.46	Stomatology – dental X-ray(2200)
NM	173	104.8	0.61	Nuclear medicine (2300)
IR	124	106.6	0.86	Industry radiography(3200)
I	268	121.0	0.45	Industry (3700)
VET	43	20.3	0.47	Veterinary (6200)
O	331	122.6	0.37	Other (2400, 2500, 6300)
Total	3118	1616.8	0.52	

*Doses below the report limits are considered as 0.04 mSv.

Table 4.9: Number of workers in separate dose intervals. Doses below the reporting limit are considered as 0.04 mSv.

	Dose interval [mSv]*						
Code of practice	< 0.5	0.5 - 0.99	1.00-4.99	5.00-9.99	10.0-14.99	15.0-19.99	> 20
DR	1347	418	91	10	0	0	0
ZR	250	56	7	0	0	0	0
NM	114	28	31	0	0	0	0
IR	92	11	18	2	1	0	0
I	242	16	10	0	0	0	0
VET	32	9	2	0	0	0	0
O	307	18	5	0	0	1	0

*Doses below the reporting limits are considered as 0.04 mSv.

Table 4.10: Collective dose by separate dose intervals (man mSv).

	Dose interval [mSv]*						
Code of practice	< 0.5	0.5 - 0.99	1.00-4.99	5.00-9.99	10.0-14.99	15.0-19.99	> 20
DR	512.0	256.2	167.7	62.4	0.0	0.0	0.0
ZR	99.4	33.3	10.4	0.0	0.0	0.0	0.0
NM	37.5	18.7	48.7	0.0	0.0	0.0	0.0
IR	35.7	6.6	39.7	11.9	12.8	0.0	0.0
I	94.9	9.1	17.0	0.0	0.0	0.0	0.0
VET	12.7	5.5	2.1	0.0	0.0	0.0	0.0
O	86.4	9.5	7.6	0.0	0.0	19.1	0.0

*Doses below the reporting limits are considered as 0.04 mSv.

In Table 4.11. the number of source inspections from 1996 and 2001 is presented.

Table 4.11.: Number of source inspections from 1996 to 2001.

Source	1996	1997	1998	1999	2000	2001
DR+TR	313	325	343	346	332	329
ZR	293	317	304	322	319	231
NM	17	19	19	12	21	20
Ind.	231	232	235	228	246	284
Written-off	27	35	60	35	38	24
Total	881	928	961	943	956	888

4.4 REPORT BY THE JOŽEF STEFAN INSTITUTE

A comment from the SNSA: the JSI report does not report on JSI activities in the field of radiation protection of its workers against radiation sources, either those of the JSI or those of other owners (except for the calibration of measuring instruments).

The research work of the Department for low and medium energy physics of the JSI involved development of novel measuring and analytical techniques in gamma spectrometry. New programmes for peak analysis were made and checked, in order to verify the results of the programmes currently in use for analytical procedure. A new method for the determination of gamma ray registration efficiency in the peak and of total efficiency was developed, to be employed for the analysis of double gamma ray cascade sources. Relations concerning the influence of uncertainties of sample parameters on efficiency uncertainties were derived. By the use of Monte Carlo simulation, a new technique for the Cs-137 depth distribution in soil was developed, to be used for in-situ gamma spectrometric measurements.

In the field of routine calibration of dosimeters used in radiation protection, the Department issued last year 283 certificates and reports for various users in Slovenia. Intercomparison of TLD measuring devices was performed for all three dosimetric services in Slovenia and for two services from the neighbouring countries (Zagreb, Sarajevo). In co-operation with a research group of the Rudjer Bošković Institute, the characteristics of these systems according to the standard IEC1066 were determined and energy dependency of new TLD materials was measured.

The JSI's Department for low and medium energy physics performs and co-ordinates regular radioactivity monitoring in the environment of the Krško NPP. These activities are presented in a separate annual report.

Experts from the Department co-operate as advisers at IAEA activities, in the developing and writing of standards and recommendations in the area of emergency preparedness for nuclear and radiological accidents, in the development of a system for immediate remediation in case of such accidents, and in IAEA education and training around the world.

4.5 REPORT BY THE ONCOLOGICAL INSTITUTE

This chapter presents the work concerning use of radioactive sources use at the Oncological Institute in the year 2001, as given in the report of the Institute's department for radiation protection.

In the year 2001, the Oncological Institute used:

– 12 X-ray devices (3 devices for breast radiography, 3 for diagnostic radiography , 1 for the control of inserted brachyradiotherapeutic applicators, 1 for mobile diagnostic radiography, 1 for experimental radiography, 1 X-ray source for the radiotherapy, 2 X-ray

sources for the simulation of radiotherapeutic irradiation); 1 X-ray device has been out of service for several years,
- 2 irradiation devices with a built-in Co-60 source,
- 3 linear accelerators, of which 1 was put out of service in June. In autumn, a new linear accelerator VARIAN Clinac 2l00 C/D was installed and first physical measurements of electron energy were performed.

The Brachyradiotherapeutic department uses various radiotherapeutic applicators with isotopes Ir-192, Cs-137, Sr-90/Y-90.

All of these radioactive sources were checked regularly in 2001 by the authorised organisations JSI and IOS.

4.5.1 UNSEALED RADIATION SOURCES

The Isotope Laboratory of the Oncological Institute used various radioactive isotopes (mostly I-131 and Tc-99m) for diagnostic purposes in the year 2001. The personnel were also responsible for the performance of I-131 therapeutic procedures. The Brachyradiotherapeutic department used only an unsealed I-131 source in 2001. The department personnel took care of the patients who received a therapeutic portion of I-131. In 2001, altogether 134 I-131 therapeutic procedures were performed. The Biochemical laboratory, which holds a licence for the purchase and usage of radioactive I-125 and H-3, did not purchase or use any of these isotopes in 2001. The Department of tumour biology held a licence for the purchase and usage of radioactive Rb-86, but did not purchase or use it in 2001. All of the unsealed radiation sources were regularly inspected in accordance with the legislation. The inspections were carried out by the authorised organisations JSI and IOS.

4.5.2 PERSONAL DOSIMETRY

The Oncological Institute workers are monitored through the regular dosimetric control by TLDs of the JSI. In addition, the most exposed workers at the Isotope laboratory and the Brachyradiotherapeutic department also use the RADOS electronic personal dosimeters which were purchased a few years ago. It is evident from the report of the cumulative dose of exposed workers at the Oncological institute in the year 2001 that most of the exposed workers did not exceed the annual dose of 1 mSv. Doses above 1 mSv were received by 8 workers at the Isotopic Laboratory and 11 workers at the Brachyradiotherapeutic department. The maximum dose of 8.8 mSv was received by a medical nurse at the Brachyoradiotherapeutic department.

4.5.3 MEDICAL EXAMINATIONS

In the year 2001, all but 4 workers from the Oncological Institute working with ionising radiation passed the obligatory medical examination at the authorised organisation, the IOS – Centre for the occupational medicine.

4.5.4 RADIOACTIVE WASTE

At the Isotope Laboratory of the Oncological Institute, low-radioactive laboratory waste is collected daily and deposited into 60-litre plastic barrels, which are then closed and transferred to a designated place for the radiological cooling (radioactive decay) process. After a certain period, this (now non-radioactive) waste is given away to an authorised organisation for carting off (in the year 2001, this was not done). The Brachyradiotherapy department produced:
- low radioactive waste, which was treated as described above,

- solid radioactive waste; at the time of reporting, the following sources were waiting for carting off: ruthenium eye applicators (Ru-106), some used iridium wires (Ir-192) and granulate of Co-60 (estimated activity in 1999 was 111 kBq)
- liquid radioactive waste, produced by therapeutic procedures with radioactive I-131. The faecal sludge is collected in a two-vessel container and released into the hospital sewage system only after a defined period (about 6 months), required for the activity of the radionuclide to decrease below the prescribed limit for tap water activity. The activities of the releases are typically between 500 and 2000 Bq/m^{-3}. A sample is taken prior to each release and then sent for I-131 determination to the authorised organisation. The two-vessel container has been in use since 1997.

In accordance with legislation, the Oncological Institute does not release radioactive materials into the biosphere.

4.5.5 RADIATION DETECTORS

The Oncological Institute uses 3 devices for surface contamination determination and 7 devices for radiation measurements. Calibration of these devices in 2001 (April, June) was performed at JSI, which acts as the National Laboratory for Dosimetric Standards, and afterwards calibration certificates were delivered to the Oncological institute. Due to permanent unavailability, 3 Berthold channel monitors were written off (The report on instrument examination, JSI, 28 March 2001).

4.5.6 TRAINING IN RADIATION PROTECTION

In accordance with the valid legislation, the Oncological Institute, together with the authorised organisation IOS, organised a Training course on ionising radiation protection. In 2001, two Oncological institute workers participated in this course, which was organised by IOS. In 2001, 3 workers of the Oncological Institute passed the examination (organised by IOS) on ionising radiation protection.

4.5.7 CO-OPERATION WITH HIRS

Every three months, the Oncological Institute reports to HIRS on the amount of purchased and used radioactive I-131 and I-125. Two health inspectors carried out 2 inspections in 2001 (11 January, 15 May). In 2001, HIRS issued the following licences to the Oncological Institute: a licence for purchase and usage of radioactive substances – unsealed radiation sources (1st February); a licence allowing the use of X-ray device SLS with CT option (20 December) and a licence for the calibration and testing of the accelerator VARIAN CLINAC 2100 C/D (24 December).

4.5.8 CO-OPERATION WITH AUTHORISED ORGANISATIONS

In the field of ionising radiation protection, the Oncological Institute co-operates regularly with the authorised institutions JSI and IOS. In 2001, co-operation with these organisations was very good.

4.5.9 THE RADIOLOGICAL INCIDENTS /ACCIDENTS

On 24 May, radiological engineers informed the radiation protection service that two patients who were irradiated by a linear accelerator, had already been irradiated previously with the therapeutic amount of I-131 at the Department of nuclear medicine of the University Medical Centre in Ljubljana. These cases were investigated and it was found (information by M.Sc. Marko Grmek, Department of nuclear medicine) that the first patient had received less than 555 MBq of I-131, which does not require hospitalisation (according to Regulation Z4). The second patient received 814 MBq of I-131 and she was hospitalised at a special section of the

Department of nuclear medicine, from where she was released three days later. During the time of hospitalisation, this patient was also irradiated at the Oncological Institute. The radiological engineers performing the irradiation were not informed of the previous therapy of the patient, so they did not use the basic principles of protection (possibility of contamination, application of proper distance and time). Even presuming that the TRT treatment was medically justified (the patient's benefit from the combination of two simultaneous therapeutic procedures), the report states that according to the Oncological institute this therapeutic procedure was not carried out properly.

At a meeting requested by the radiological engineers, it was proposed that the rules for such cases should be discussed by the responsible persons of the Oncological Institute and the Department of nuclear medicine. Ms Alenka Vodnik-Cerar, the deputy head of the Radiotherapy department, held a meeting with representatives and with the director of the Department of nuclear medicine. She stated (letter of 22 June) that during the irradiation the residual activity of both patients was below 555 MBq. A conclusion was derived that in future such patients should either be irradiated before the therapeutic amount of I-131 is applied to them, or only after the residual activity in the patient becomes negligible.

There were no other radiological incidents or important contaminations at the Oncological Institute in 2001.

4.5.10 OTHER

In the period of 2-6 July 2001, the expert mission from the IAEA (ORPAS) in Slovenia also visited the Oncological Institute to check the status of radiation protection of workers and patients. A preliminary report on the inspection findings was written and sent to the Oncological Institute in October 2001. Their recommendation was that the Oncological institute should find another contractor for personal dosimetry, in order to increase the accuracy of the readout doses of the workers whose workplaces are in areas of ionising radiation with mixed energies. In the mission's opinion, prompt execution of this recommendation was required, so the Oncological Institute asked the JSI dosimetric service to comment on this statement. No answer in written form was received from the JSI.

4.6 REPORT OF THE NUCLEAR MEDICINE CENTRE AT THE UNIVERSITY MEDICAL CENTRE IN LJUBLJANA

Nuclear medicine is a medical activity aiming to discover and treat illnesses by radiopharmaceuticals, which are substances marked by a radioactive isotope.

The Nuclear medicine centre in Ljubljana performs therapeutic procedures and diagnostic examinations with the use of radioactive isotopes. The number of therapeutic and diagnostic procedures in the year 2001 are shown in Tables 4.12 and 4.13 respectively. The activities of the radiopharmaceuticals used are as low as possible but high enough to provide satisfactory diagnostic information or the desired therapeutic effect. As a rule, the activities recommended by the European association for nuclear medicine are followed.

Table 4.12: Type and number of therapeutic procedures in 2001 at the Nuclear medicine centre, Ljubljana .

Type of therapeutic procedure	Number
Medical treatment of thyroid illness with I-131	445
Medical treatment with Y-90	2

Table 4.13: Type and number of diagnostic examinations in 2001 at the Nuclear medicine centre, Ljubljana.

Type of diagnostic examination	(radioactive isotope)*	Number
Scintigraphy of thyroid with technetium	(Tc-99m)	2346
Scintigraphy of skeleton	(Tc-99m)	1437
Perfusive and ventilative scintigraphy of lungs	(Tc-99m and Xe-133)	802
Sequential scintigraphy of kidneys	(Tc-99m)	764
Scintigraphy of miocardium by MIBI	(Tc-99m)	727
Iodine accumulation in thyroid	(I-131)	433
Scintigraphy with marked leucocytes	(Tc-99m)	256
Radioisotopic myction cistography	(Tc-99m)	165
Scintigraphy of pancreas	(Tc-99m)	150
Scintigraphy of kidney's parenchyma	(Tc-99m)	146
Scintigraphy of brains	(Tc-99m)	84
Scintigraphy of chemangiome	(Tc-99m)	78
Scintigraphy of parathyroid	(Tc-99m)	52
Other diagnostic examinations **	(different)	307

* In brackets the radioactive isotope used in the examinations is given.

** This refers to the total number of all other diagnostic examinations with a frequency below 50.

4.7 REPORTS OF THE AUTHORISED ORGANISATIONS FOR MEDICAL EXAMINATIONS OF WORKERS

4.7.1 ARISTOTEL D.O.O.

Medical examinations of the workers in the controlled area of the Krško NPP are performed by the authorised organisation Aristotel, d.o.o. The results of the medical examinations for the year 2001 are shown in Table 4.14. In the Figure 4.4 the number of examined workers is presented against their age and the estimate of working ability, while in the Figure 4.5 the estimate of working ability is shown in percentage.

Table 4.14: Medical examinations of workers, who work in controlled area of Krško NPP, for the year 2001.

Estimate of working ability	Total		Age		Sex
	Number	percent	18-40	over 40	M
1. Able to work	185	63.8	104	81	185
2. Able to work with limitations	98	33.8	46	52	98
3. Temporary unable for this work	6	2.1	2	4	6
4. Unable to perform this work	1	0.3	0	1	1
5. Able for another job (profession)	0	0.0	0	0	0
6. Estimation of working ability is impossible	0	0.0	0	0	0
Total	290	100	152	138	290

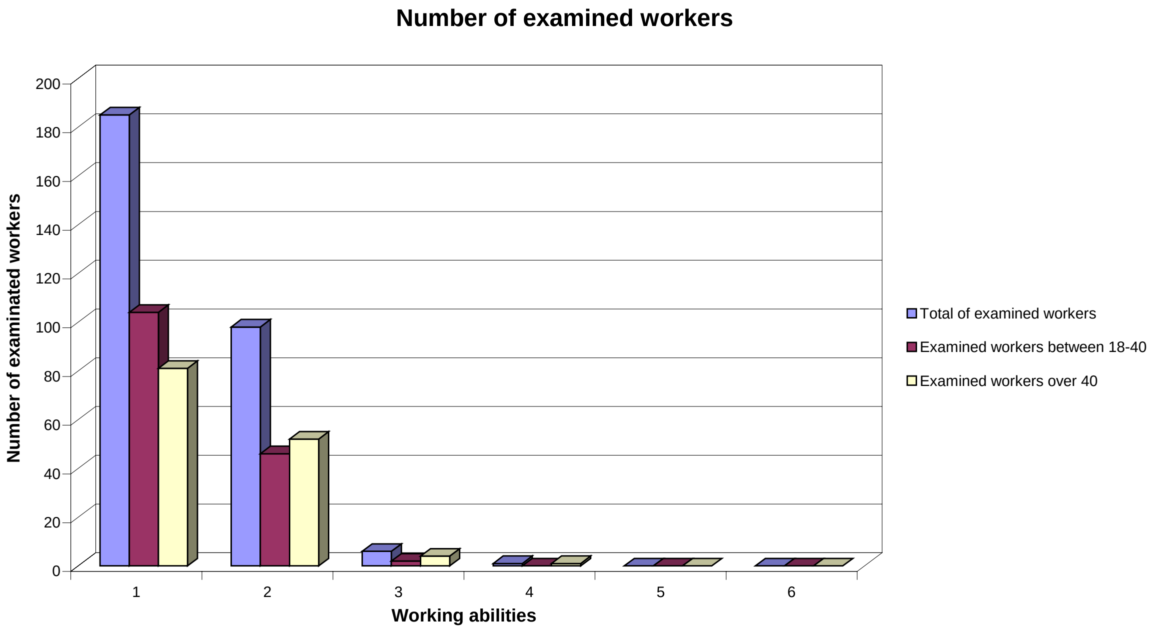

Figure 4.4: Number of examined workers according to age and working ability (see categories "Working ability" No. 1-6 in Table 4.14).

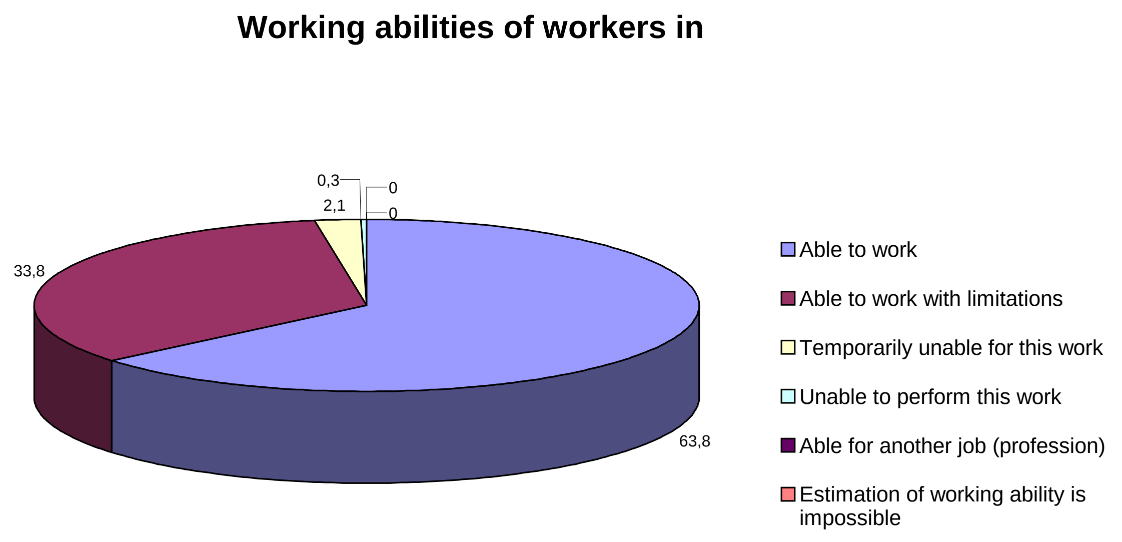

Figure 4.5: Estimate of working abilities of workers, expressed in percentage.

4.7.2 CLINICAL INSTITUTE OF OCCUPATIONAL, TRAFFIC AND SPORTS MEDICINE

In 2001, the Clinical institute of occupational, traffic and sports medicine performed activities connected mainly with radiation protection and nuclear safety. The main content of work results from the sharing of authorisation on performance of individual activities in the field of active health protection (14 September 1984).

1. Activities of the Clinical institute of occupational, traffic and sports medicine

a) Performing active health protection

The performance of active health protection was limited to preventive medical examinations of workers exposed to unsealed and sealed sources of ionising radiation. These workers come from very different, but mainly medical working environments. Altogether 288 workers were examined in 2001. The analysis of the results of preventive medical examinations showed no illnesses included in the list of occupational illnesses (Official Gazette SFRY, No. 38/83). Health protection was carried out in the Centre for ionising radiation, the Dispensary for occupational medicine of the University Clinical Centre and in the Centre for psychology. No other activities of medical protection were performed, nor there was any co-operation regarding risk estimation for the workers exposed to ionising radiation.

The Centre for psychology co-operated in the formation of procedures for assurance of availability for work in nuclear facilities.

b) Co-operation in preparation of legislation and regulations

The staff of the Clinical institute of occupational, traffic and sports medicine co-operated in the preparation of the new national legislation in the field of radiation protection and nuclear safety.

c) Active participation in expert meetings
The staff of the Clinical institute of occupational, traffic and sports medicine also presented their expert findings at expert meetings.

d) Training

In the framework of the regular qualification training, performed at the Centre for radiation protection, the Dispensary for occupational medicine and the Centre for psychology, specialists in occupational medicine are acquainted with specific measures of health protection and preservation of working ability of workers in ionising radiation environments.

2. Estimate of health protection for occupationally exposed workers in Slovenia

According to the Clinical institute of occupational, traffic and sports medicine there is at present no efficient and valid system of health control of all the workers who are exposed to ionising radiation. The preventive control is very irregular, especially in medicine. Because of this there are no valid integral data on the health risk of these workers, nor on the risk of stochastic effects that would lead to some efficient and complex measures. The general data about this issue are based on the dosimetric register. It would be necessary for active health protection to make it uniform and organise it at a single institution which would develop and supplement the existing doctrine with knowledge and experience of other institutions around the world.

Performance of the complex health protection of workers exposed to ionising radiation as well as such formation of a single institution should become one of the priorities in Slovenia. The Clinical institute of occupational, traffic and sports medicine has prepared a good basis for the development of this activity at a national level, in a relatively short time and at a reasonable cost.

4.7.3 INSTITUTE OF OCCUPATIONAL SAFETY

In 2001, examination of altogether 2009 persons working with radioactive sources or in ionising radiation environment was carried out by IOS. The number of workers in various working areas is shown in Table 4.15.

Table 4.15: Number of workers in various working areas.

Field of work with/near ionising radiation	Male	Female	Total
Workers in medicine	732	906	1638
Workers in industry	247	5	252
Workers in mining industry	17	0	17
Workers in training and research activities	49	53	102
Total	1045	964	2009

The data are classified only according to working areas and sex, but not according to age and working ability estimate.

Medical examinations of the above mentioned workers were carried out according to Regulation Z5 and consisted of:

- Examination by the specialist of occupational, traffic and sports medicine, with a special emphasis on dosimetry evaluation,
- Biochemical analysis of blood and urine check,
- ECG
- X-ray of lungs (only at appointment for the occupation),
- examination of eye lenses (biennially or more frequently on request of the ophthalmologist)
- in some cases, according to Regulation Z5, determination of the ratio of chromosome structural aberrations and total gamma activity is also required for the worker.

With regard to the pathological results, turbidness of the eye lens was found in 25% of examined workers. In none of these cases were the ophthalmology specialists able to relate this to the occupation of the workers; they only recommended further monitoring and use of personal protection means. All the examined workers were found either to be able to perform the proposed work or capable with some temporal or objective limitations, as can be seen from individual health certificates (limitations on work with ionising radiation sources are just warnings to consistently use the proposed personal protection devices and to undergo a re-examination after a 12-month period as prescribed by law). The other recorded limitations were not connected with work with sources of ionising radiation.

In 2001, IOS performed 6 health examinations of workers working with radiation sources due to some unexpected high doses acquired in a certain time period. All these workers were thoroughly examined by analysing the irradiation doses and checking their working environment.

In the framework of radiation protection against ionising radiation, IOS performed some research work, the results of which were published in international scientific periodic publications or in the form of conference proceedings.

5 RADIOACTIVE SUBSTANCES

5.1 TRANSPORT OF RADIOACTIVE AND NUCLEAR SUBSTANCES

Transport of radioactive and nuclear substances in Slovenia is regulated by the following Acts:

Act on carriage of dangerous goods, (Off. Gaz. RS, No. 79/99; ZPNB).
- Decision of publication of Annex A and Annex B of the European Agreement concerning international transport of dangerous goods by road, (Off. Gaz. RS, No. 41-I/2000 and 41-II/2000; ADR).
- Act on Radiation Protection and the Safe Use of Nuclear Energy, (Off. Gaz. SFRY, No. 62/84; ZVISJE).
- Act on Implementing Protection against Ionising Radiation and Measures for the Safety of Nuclear Facilities, (Off. Gaz. SRS, No. 28/80; ZIVIS).
- Convention concerning International Carriage by Rail (COTIF), (Off. Gaz. SFRY- MP., No. 8/84), a constituent part of which is the Rules on International Transportation of Dangerous Goods by Rail (RID).
- International Convention on Safety of Human Life at Sea, 1974, (Off. Gaz. SFRY- MP., No. 2/81).
- Protocol Amending the International Convention on Safety of Human Life at Sea, 1974, (Off. Gaz. SFRY- MP., No. 2/81) and
- Convention on International Civil Aviation, (Off. Gaz. FLRY- MP., No. 3/54, 5/54, 9/61, 5/62 and Off. Gaz. SFRY- MP., No. 11/63, 49/71, 62/73, 15/78 and 2/80).

With regard to the subsidiary regulations of conditions for transport concerning the type of vehicles, the Ministry of the Interior only issued regulations for the carriage of dangerous goods by road. The Ministry of Transport and Communications has not yet issued regulations concerning conditions for transport by rail, air and sea.

All international conventions and agreements concerning transportation of dangerous goods are included in Article 3 of the ZPNB. These conventions and agreements include IAEA recommendations. In the year 2000, the IAEA issued a revision of "Regulations for the Safe Transport of Radioactive Materials" No. TS-R-1 (ST- 1, Revised).

The ZPNB also introduced the concept of a safety adviser. With respect to this, the Minister of Labour, Family and Social Affairs approved a programme of professional and vocational education of safety adviser for the transport of dangerous goods which had previously been approved by the Council for professional and vocational education (Decree on educational programme for professional and vocational education, Off. Gaz. RS, No. 125/2000). Education is performed by the Institute for Occupational Safety, Ljubljana, and the Institute for Occupational and Environment Safety, Maribor.

The Minister of Environment, Spatial Planning and Energy, in agreement with the Minister of Health, is responsible for issuing permits for transportation of radioactive and nuclear substances. The Minister of Health is also responsible for issuing permits for transport of radio-pharmaceuticals. The ministries delegated the authority to the director of the SNSA and to the chief inspector of the HIRS.

Radioactive sources are delivered by shipments to the place of use (e.g. medicine, industry, research institutions). The SNSA issued one licence for transport of fresh fuel elements for the Krško NPP in the year 2001. In April 2000, the fresh fuel was shipped by sea and arrived from the USA to the port of Koper and then by road to the Krško NPP.

Last year only two licences for transportation of radioactive substances were issued - one for industry and the other one for research. Most shipments do not require the license. The details of requirements for the safe transport are given in Annex A of the European Agreement concerning International carriage of dangerous goods by road.

The most frequent isotopes transported last year were: Ir-192, I-131, Co-60, Cs-137, H-3. Concerning the number of shipments, the isotopes were classified as follows: I-125, I-131, Sr-89, Y-90, Xe-133, Ir-192, Co-60, Cs-137, I-123. The isotopes were mainly transported in the following packages: excepted, type A and type B(U).

Slovenian enterprises and foreign carriers also performed transit of isotopes through Slovenia to Hungary and Croatia.

For the purpose of illustration, some Regulations concerning the classification of packages are shown in Table 5.1. These packages are classified as: excepted package, industrial package, types A, B and C packages, package with dispersible substances (not capsulated) and package for which special regulation measures are not needed. The classification of packages depends on their specific activity (A_0) and their total activity (A). For each group of packages, except for the package which does not require any special regulation measures, the regulations define the provisions which ensure safe transport. A_2 means the activity of the package which is given in the "Regulations for the Safe Transport of Radioactive Material", No. TS-R-1 (ST-1, Revised), edition 2000.

Table 5.1: Classification of packages: package with dispersible substances (not capsulated), excepted package, industrial package, type A package, type B package, type C package and a package which does not require any special regulation measures.

Specific Activity of package A_0	Classification of package			
$A_0>2 \times 10^{-3}\ A_2/g$	Excepted package	Type A	Type B	Type C
$A_0>70$ Bq/g		Industrial package		
$A_0=<70$ Bq/g	Package exempted from regulations			
	$A<10^{-3}\ A_2$ *	$10^{-3} < A < A_2$*	$3000A_2 > A > A_2$ *	$A>3000A_2$ *
	Total activity of package A			

*A_2 means the activity of the package for each radioactive isotope regarding its radiotoxicity; A_2 is given in "Regulations for the Safe Transport of Radioactive Material", No. TS-R-1 (ST-1, Revised), edition 2000.

In "Regulations for the Safe Transport of Radioactive Material", No. TS-R-1 (ST-1, Revised), edition 2000, classification of non-dispersible radioactive substances is also given by its activity A_1. Also the dose rate limits on the surface of packages by transport index (TI) are given .

The above-mentioned regulations also prescribe safety of the performer of transport, as well as of residents during the transport of radioactive substances.

5.2 INSPECTION MONITORING IN ACCORDANCE WITH THE ACT ON TRANSPORTATION OF DANGEROUS GOODS

In accordance with the Act on transportation of dangerous goods, two inspections of carriers of radioactive sources were performed in 2001.

Inspectors visited the Slovenian National Building and Civil Engineering Institute and examined the company, the inventory of radioactive material, the vehicles for transportation of dangerous substances, records, dosimetry, procedures and storage. The SNSA required from the institute to: independently keep record of transportation of dangerous materials, ensure a safety adviser and install dosimeters in the storage for measurement of outside radiation.

The SNSA inspectors also visited the firm TEMAT and examined the company, the inventory of radioactive material, the vehicles for transportation of dangerous substances, records, dosimetry, procedures and storage. No irregularities were found.

5.2.1 SNSA INTERVENTION IN RADWASTE STORAGE

In accordance with the Act on transportation of dangerous goods, the SNSA inspectors performed two irregular inspections in 2001. On 20 July, a radioactive lightning conductor was found and examined at the company (scrap-yard) PIVKA (Eu-152/154). Based on the SNSA decision it was then transported to the central storage at Brinje. On 17 October, another radioactive lightning conductor (Eu-152/154) from the Motel Grosuplje was transported to the central storage at Brinje. A detailed description of the interventions is presented in paragraph 5.6.

5.3 IMPORT AND EXPORT OF RADIOACTIVE SUBSTANCES

In compliance with the Decree on Export and Import of Specific Goods (Off. Gaz. RS; No. 111/2001, 20/2002), the SNSA issues licences for import of fresh fuel elements and licenses for export or import of radioactive substances which are needed in hospitals (diagnostic, therapy), research institutes and industry. The SNSA also issues licences for the goods stated in Appendix II of the Decree.

In accordance with the Decree, the SNSA issued 124 licences in 2001. 50 licences were issued for a single import, 60 for a multiple import and 14 for export of radioactive substances.

The biggest importers of radioactive sources in Slovenia were: Biomedis, Karanta Ljubljana Trade company, Genos , Iris , NPP Krško, Temat , and IMP Promont kontrolor ndt Črnuče. All other companies import radioactive sources only periodically. The main imported radioisotopes were Ga-67, Kr-85, Sr-89, Y-90, In-111, I-125, I-131, Xe-133, Ir-192, Tl-201 in Tc-99m.

Picture 5.1 presents the import of some of the main radioactive isotopes. A detailed review of import of radioactive isotopes in the year 2001 is presented in Table 5.2 (part 1 and 2).

Slovenian enterprises (Karanta Ljubljana Trade company, NPP Krško, JSI, IMP Promont kontrolor ndt Črnuče, SŽ STO d.o.o.) exported approximately 32 TBq of radioisotopes (Co-60, Ir-192 and Cs-137) to Germany.

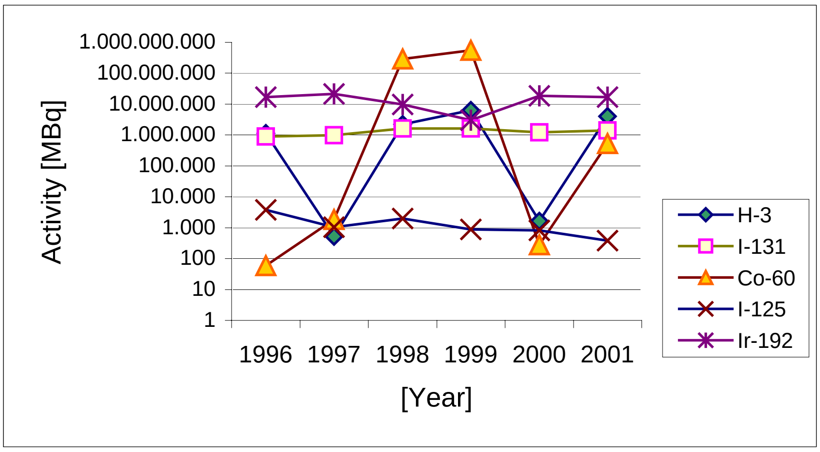

Figure 5.1: Import of some radioactive isotopes for the period 1996 to 2001.

Table 5.2: Import of radioactive isotopes in the year 2001 – Part 1 (MBq).

USER/ISOTOPE (MBq) (Half life) (y.d.h.m)	H-3 (12.3 y)	C-14 (5730 y)	S-35 (87.4 d)	Sc-46 (83.8 d)	Cr-51 (27.7 d)	Mn-54 (312.5 d)	Fe-55 (2.7 y)	Co-57 (270.9 d)	Co-60 (5.3 y)	Ni-63 (96 y)	Ga-67 (78.26 h)	Sr-85 (64.8 d)	Sr-89 (50.5 d)	Sr-90 (29.1 y)	Y-90 (64.0 h)	Ru-106 (368.2 d)	Cd-109 (464.0 d)	In-111 (2.8 d)
Acroni Jesenice																		
Alusil									788									
Faculty for Biotechnic		16.67																
Hospital of Celje								0.148			410							122
Hospital of Maribor					6738			0.241										854
Hospital of P. Držaja		7.4																
Hospital of Slov. Gradec																		
Hospital of Derganc																		
Hospital of Izola																		
Cestno podjetje Lj.																		
Cinkarna Celje																		
Faculty for pharmacia										611								
Faculty for veterinary																		
Fotona d.d.	368500																	
Gimnazija Bežigrad														0.037				
JSI		111	18.5	0.011		0.01			0.1	1222		0.8		0.01			0.01	
IMP Promon. kontrolor																		
Institute of hm/piv. Žalec										611								
KC IKKKB																		
KC KNM. LJ.					814			0.482	1						7955			4015
KC Očesna klinika																212		
Lesonit																		
MF Institute of microbiology	185																	
MO RS	3700000																	
National Institute for biology	148																	
NEK																		
Oncological Institute Ljubljana								37			11890		1036					1468
Pivovarna Laško																		
REMATS							1660										185	
SŽ str/opr Ravne									531000									
Temat d.o.o. Sl. Bistr.																		
Zavod za gradbeništvo																		
Zavod za trans. krvi	111																	
IOS. Lj					111													

Total 2001	4.1E+06	135	18.5	0.01	7663	0.01	1660	38	5.3E+05	2444	12300	0.8	1036	0.05	7955	212	185	6459

Table 5.3: Import of radioactive isotopes in the year 2001 – Part 2 (MBq).

USER/ISOTOPE (MBq) (Half life) (y. d. h. m)	Sn-113 (115.0 d)	I-125 (60. 1 d)	I-131 (8.0 d)	Ba-133 (10.7 y)	Xe-133 (5.3 d)	Cs-137 (30.0 y)	Re-186 (90.6 h)	Ir-192 (74.0 d)	Tl-201 (3.0 d)	Hg-203 (46.6 d)	Po-210 (138. 4 d)	Pa-231 (32760 y)	Am-241 (432. 2 y)	Am-241/Be	Mo99/Tc-99m (66.0 h/213000 y)	kalib.stand.mešanice
Acroni Jesenice						1110000										
Alusil																
Faculty for Biotechnic																
Hospital of Celje		14.83	64406				1425		170						851200	
Hospital of Maribor		13.58	59977				12825		30500						1045000	
Hospital of P. Držaja																
Hospital of Slov. Gradec			34632												71500	
Hospital of F. Derganc															312000	
Hospital of Izola		31.02	4014.5												117550	
Cestno podjetje Lj.						296								1480		
Cinkarna Celje						1480										
Faculty for pharmacia																
Faculty for veterinary m.		1.24														
Fotona d.d.																
Gimnazija Bežigrad						0.37							0.037			
JSI	0.01					0.001				111	0.01	0.0022		37		0.42
IMP Promon. Kontrolor								3327000								
Institute of hm/piv. Žalec																
KC IKKKB		30.17														
KC KNM. LJ.		285.50	575831	1	192400	1	555		765						2312500	1
KC Očesna klinika																
Lesonit						9200							3700			
MF Institute of microbiology		0.83														
MO RS																
National Institute for biology																
NEK					1850											50.87
Oncological Institute Ljubljana		0.30	690531												1820000	
Pivovarna Laško													1670			
REMATS																
SŽ str/opr Ravne								2874300								
Temat d.o.o. Sl. Bistr.								10363600								
Zavod za gradbeništvo.						296								1480		
Zavod za trans. krvi																

IOS. Lj																3.33
Total 2001	0.01	377.5	1.4E+06	1	1.9E+05	1.1E+06	14805	1.7E+07	31435	111	0.01	0.002	5370	2997	6.5E+06	55.6

5.4 NUCLEAR NON-PROLIFERATION

5.4.1 SAFEGUARDING OF NUCLEAR MATERIALS IN SLOVENIA

Slovenia has signed the Non-Proliferation Treaty and has concluded the Agreement with the IAEA on safeguards in connection with the Non-Proliferation Treaty ("Safeguards Agreement").

This agreement defines, among other things, the measures relating to safeguard of nuclear materials, the national system of inventory book-keeping, archiving and inspection of nuclear materials, subsidiary arrangements, performance of IAEA inspections, etc.

The nuclear materials which are subject to IAEA inspections are located at the Krško NPP and the Research Reactor Triga. Nuclear material is found in fuel assemblies (small quantities of nuclear material were exempted). Table 5.4 shows the number of IAEA inspections since 1996. No irregularities were found during these inspections. The SNSA reported to the IAEA in accordance with the Safeguards Agreement.

The IAEA carries out approximately one inspection per 4 years at the Research Reactor Triga. The last regular inspection was carried out in 1998.

The SNSA began to examine the possible possession of small quantities of nuclear material (by small holders). The aim is to find out whether all reporting to the IAEA is in accordance with the provisions of the Safeguards Agreement.

Table 5.4: Data on the number of IAEA inspections in Slovenia since 1996.

Year	Krško NPP	Research Reactor Triga
1996	7	0
1997	5	0
1998	5	1*
1999	6	1
2000	7	0
2001	7	0

* inspection due to the shipment of spent nuclear fuel to the USA

5.4.2 PROTOCOL ADDITIONAL TO THE SAFEGUARDS AGREEMENT

Slovenia signed the Protocol Additional to the Safeguards Agreement with the IAEA in connection with the NPT in 1998, and ratified it in 2000. The Protocol Additional came into force on 22 August 2000. The SNSA prepared the initial report and sent it to the IAEA on 21 February 2001.

The IAEA reviewed the initial report and requested additional explanation. The SNSA prepared, with the help of the Krško NPP, the JSI and Rudnik Žirovski vrh, a detailed answer and sent it to the IAEA on 11 December 2001. This additional explanation concerns details on the status of decommissioning works, quantities of the produced yellow cake, spent fuel management at the Krško NPP, and further activities at the JSI in the area of research related to the nuclear fuel cycle.

For the first time followed the routine inspection of IAEA inspectors at the Krško NPP was followed by an unannounced inspection, in accordance with Article 4.b.(ii) of the Protocol Additional.

5.4.3 COMPREHENSIVE NUCLEAR TEST-BAN TREATY

The Comprehensive Nuclear Test-Ban Treaty (CTBT) is an important additional international measure preventing the proliferation of nuclear weapons. The Republic of Slovenia signed it on 24 September 1996 and ratified it on 31 August 1999.

Between 11 and 13 November 2001, a Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty was held in New York. A Slovenian delegation also participated in this event.

The condition for the CTBT to enter into force is ratification by 40 states including all nuclear-weapon states, i.e. also India, Pakistan and North Korea. It is quite likely that this condition will not be fulfilled and the CTBT will not enter into force yet. However, the Comprehensive Nuclear Test-Ban Treaty Organisation (CTBTO) which was founded in Vienna has already established an international monitoring system for the detection of nuclear explosions. Slovenia, as a signatory to the CTBT, is also a member of the CTBTO and regularly participates in the work of this international organisation. The SNSA notifies the following Slovenian institutions on CTBTO activities: the Environmental Agency, the Geological Survey of Slovenia, the JSI and the Institute for Occupational Safety.

5.4.4 EXPORT CONTROL OF DUAL-USE GOODS

Slovenia has to harmonise its legislation with those of various Euro-Atlantic organisations and has thus adapted it also in the field of non-proliferation of weapons for mass destruction with the EU regulations. The Slovenian legislation is comparable with the EU requirements in this field - i.e. with Council Regulation No. 3381 and Council Decision No. 94/942CFSP. Acceptance of these regulations concerning export of goods which could be applied for the production of weapons for mass destruction enabled Slovenia to become a full member of two international organisations in 2000: the Zangger Committee (ZC) and the Nuclear Suppliers Group (NSG).

There were two sessions of the ZC in Vienna (May, October) and two sessions of the NSG (May, Aspen-USA; November, Vienna). SNSA representatives took part in all sessions except in the plenary meeting in Aspen. Information among the SNSA, the ZC and the NSG is exchanged through the Slovenian Embassy in Vienna. In 2001, the SNSA reported to both organisations in accordance with their rules.

In accordance with the Act on Export of dual-use goods, an exporter has to make an application for a licence to the Ministry of Economy. Depending on the nature of goods the Ministry of Economy has to receive approval by competent ministries and regulatory bodies. The opinion on the export of goods that could be used for the production of nuclear weapons is issued by the SNSA. In 2001, the SNSA did not receive any such requirements from the Ministry of Economy.

At the end of 2001, the Ministry of Economy formed a special informal group consisting of representatives of all organisations involved in this area: Ministry of Economy, Ministry of Foreign Affairs, Slovenian Security Intelligence Agency, Ministry of Environment, Spatial Planning and Energy - SNSA, Ministry of the Interior, Ministry of Health - Agency for Medicinal Products, Ministry of Finance - Customs Administration and Ministry of Defence. The main task of the group is to be familiar with topical issues after the Act on Export of dual-use goods entered into force. Besides, a regional bureau *»Export Control Border Security Office«* for Slovenia, the Czech Republic, Slovakia, Croatia and Hungary was opened by the US Government in spring 2001. The bureau is meant to help these countries in the field of non-proliferation of weapons of mass destruction. Assistance is provided through donations of equipment and in the form of education.

5.4.5 PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN THE REPUBLIC OF SLOVENIA

Physical protection of nuclear facilities and materials at the Krško NPP, the Research Reactor Triga and the Central L/ILW storage at Brinje is in accordance with regulations. The co-operation between the Ministry of the Interior (MI) and the SNSA in the field of physical protection of nuclear facilities and materials is very good. The physical protection system of the Krško NPP is supervised regularly by SNSA inspectors and MI services.

In 2001, the Krško NPP started with modifications and replacement of all obsolete equipment and components of technical systems of physical protection. It gradually provided civil engineering documentation for confirmation. The MI and the SNSA reviewed the received documentation (»design modification package«). The entire project is foreseen to be accomplished by the end of 2002.

The physical protection system in the Research Reactor Triga was the same as in previous years.

The MI founded a special commission (*Commission for the performance of expert tasks in the field of protection of nuclear facilities and installations*) in the second half of the 90's. The commission upgraded the 'Threat assessment for nuclear facilities and installations', on the basis of data provided by the police, intelligence services, the SNSA and nuclear facility operators. This assessment was issued by the director general of the police. For the first time, the assessment was performed also for the Central L/ILW storage at Brinje, managed by the Agency for Radwaste Management.

Soon after the events in the USA (11 September 2001), the above-mentioned commission held a session where the current security situation in Slovenia was examined and possible additional measures of protection were considered. It was assessed that the security conditions in Slovenia had not changed. Irrespective of this conclusion, certain measures were taken in order to strengthen the physical protection of the Krško NPP. Since 11 September 2001 the SNSA has been systematically following all events around the world relating to physical protection of nuclear facilities. The IAEA has also strengthened its activities in this field and assigned more financial resources. The member states will be offered more technical assistance, e.g. advice, education and preparation of new guidelines.

5.5 ILLICIT TRAFFICKING OF NUCLEAR AND RADIOACTIVE MATERIALS

The area of illicit trafficking of nuclear and radioactive material has become an issue of strong international co-operation, mainly through the IAEA, the USA and the European Commission. The latter endeavours to establish a level of control in this regard in the applicant countries which would match the control within the EU.

The IAEA maintains a special database, »The IAEA Illicit Trafficking Database«, that is regularly provided to all contact points in the Member States (in Slovenia: the SNSA). The SNSA provides quarterly this information to other Slovenian institutions, such as the police and the customs office.

The PECO project of the ITU (Karlsruhe, Germany) is funded through the European Commission. The aim of the project is to supply radiometric equipment, education of experts and assistance with regard to the procedures that need to be followed when a radioactive source has been found.

In recent years, the Republic of Slovenia has established a legal basis which is comparable with that in the EU. It has been found out that better communication at the national level is needed for successful international co-operation. In this regard, an agreement has been reached to hold regular meetings of representatives of all the institutions involved (SNSA, Ministry of the Interior, Ministry of Health - Health Inspectorate, Ministry of Finance - Customs Administration and Ministry of Defence - Administration for Civil Protection and Disaster Relief). They analyse the current situation and harmonise their activities in this area.

In 2001, three cases of illicit treatment and trafficking of radioactive sources - materials were discovered in Slovenia:

- Co-60 source, found in Jesenice

Co-60 with the assessed activity of app. 80 MBq was unintentionally melted at the Acroni Jesenice ironworks on 21 February 2001. After its melting, increased radiation was discovered on stainless steel semi-products. It is assumed that the source was part of a shipment of scrap iron from Romania. More accurate measures were performed by the Institute for Occupational Safety experts. It should be stressed that the portal monitor at the entrance did not detect increased radiation during the entry of the vehicle.

- Eu-152/154 source, found in Pivka

Eu-152/154 was found on 16 July 2001. Italian border officers discovered increased radiation of a shipment of scrap iron on the Slovenian-Italian border (Gorizia). The first Slovenian measurement was performed by a local expert of the company Odpad Ltd. from Pivka, the owner of the shipment. Later, the presence of Eu-152/154 was discovered (assessed activity 6 to 8 GBq). The source was then transported to the Central L/ILW storage at Brinje.

- Eu-152/154 source, found in Grosuplje

In this case inappropriate management of an Eu-152/154 source was discovered at the company Motel Grosuplje (motel). This source, with the assessed activity of 6.1 GBq, was incorporated into a lightning conductor, which was removed without authorisation from the roof of the motel on 10 October 2001. The lightning conductor was partly dismantled and transported without the necessary licence along the route Grosuplje - Brinje - Grosuplje. Experts from ELME (mobile lab) intervened on 16 October 2001. The source was temporarily stored on site and transported to the Central L/ILW storage at Brinje the following day.

In the first two cases the SNSA sent a twin report to the IAEA on 25 July 2001, which included it in the IAEA Illicit Trafficking Database.

6 RADIOACTIVE WASTE MANAGEMENT

Radioactive waste management in various facilities in the Slovenia is described also in Chapters 2.1.4, 2.2.2, 2.3.2 and 2.4.2.

6.1 PUBLIC SERVICE RELATED TO RADIOACTIVE WASTE MANAGEMENT

In accordance with the Decree on Matter, Subject and Conditions of Economic Public Service Relating to Radioactive Waste Management (Off. Gaz. Of RS, No. 32/99; in the text: "Decree"), which concerns radioactive waste generated by small producers, the Agency for Radwaste Management should have taken over all responsibilities regarding public service already by May 2000. Because of a delay due to the refurbishment of the Central Interim Storage for Radioactive Waste at Brinje, this public service is still not performed in full scope but only in cases of emergency. Small producers have shown strong interest to fully implement this public service, since waste continues to pile at their sites.

The description of intervention entries of radioactive sources in the storage is given in Chapters 2.3.2 and 5.6.

6.2 STRATEGY ON SPENT NUCLEAR FUEL MANAGEMENT

"The Strategy on Spent Fuel Management" (in the text: "Strategy"), was approved by the Slovenian Government in the year 1996. This strategy, which had been prepared by the Ministry of Economy, the Krško NPP and the Agency for Radwaste Management, does not provide a final solution to spent fuel management, but only a deferred decision and a temporary solution. In the meantime, all necessary provisions should be applied for enlarging the spent fuel pool capacity at the Krško NPP or to consider the possibility of dry storage. the final solution on disposing of spent full has thus been postponed until 2020, while the construction of the disposal should begin in 2050 or even later. The Strategy was prepared on the basis of current experience and foreign practice and should be revised every three years. At the end of 2001, the revision had not been accomplished.

6.3 REVISION OF THE DECOMMISSIONING PLAN FOR THE KRŠKO NPP

Based on provisions of the Act on the Fund for Financing the Decommissioning of the Krško NPP and on Disposal of Radioactive Waste from the Krško NPP, the former Ministry of Economy prepared in 1996 the Decommissioning plan for the Krško NPP (Plan), in which decommissioning alternatives and the necessary financial resources are presented. The Plan is to be revised every three to five years. According to the Plan, the financial contribution to the fund should amount to 0.42 SIT for every produced kW hour. Due to previously unfulfilled obligations, however, the Krško NPP is contributing 0.61 SIT/kWh at the moment.

The former Ministry of Economy began preparing a revision of the plan. The terms of reference were prepared but the revision of the plan was not ordered although deadline for the revision was the middle of 2001. Several organisations were involved in the preparation of the basis for the terms of reference, including Slovenian and Croatian experts, and experts delegated by the IAEA.

The terms of reference were prepared in May 2001 by the Croatian company APO, d.o.o Konzalting i inženjering u zaštiti okoliša. In July 2001, the IAEA group of experts reviewed it and proposed several recommendations. They particularly stressed that a better assessment of costs of storage, transport and disposals of spent fuel and L/ILW should be made. These costs represent approximately 80% of all decommissioning costs.

6.4 STRATEGY OF LOW AND INTERMEDIATE LEVEL WASTE MANAGEMENT

Besides the Strategy of spent nuclear fuel management and the Krško NPP Decommissioning Plan, the Strategy on Low and Intermediate Level Waste Management should be one of the key documents in the field of radioactive waste management in Slovenia. In the year 2000, the Agency for Radwaste Management prepared a "Proposal of Strategy o Low and Intermediate Level Waste Management" and sent it to the Government for approval. Due to the fact that a new government was elected, these documents were not dealt with in 2000 and were sent to the Agency for updating and amendment. The Agency for Radwaste Management had not done this by the end of 2001.

6.5 CONSTRUCTION OF LILW DISPOSAL

6.5.1 SITE SELECTION FOR LILW DISPOSAL

The basic conditions for a final solution for LILW is to obtain the location for the disposal site and its construction. With this goal in mind, the Agency for Radwaste Management prepared a combined procedure to find the location, trying to establish a balance between technical and social aspects. According to the Agency, such treatment provides proper flexibility of the procedure and enables participation and co-operation of the public in the procedure; additionally, a mediator has been proposed as a link between the investor and the local community. The mediator represents a new element in the combined procedure to obtain a location for the disposal site; it would provide mutual exchange and sharing of information and facilitate agreement between the two parties.

The procedure itself is in coherence with the IAEA recommendations and divided into four stages: design and planning, spatial assessment, characterisation of the location and its confirmation as the last stage. In 2001, the Agency for Radwaste Management concluded the important step of spatial assessment, the main goal of which was to identify potentially appropriate areas for the disposal of LILW in Slovenia. During this second stage, the Agency for Radwaste Management took into account particularly those measures which concern the safety and integrity of the disposal site. These measures were first evaluated at a special workshop. The spatial assessment was made from the viewpoint of geological considerations. The findings of the workshop contributed to the evaluation of the national potential for the disposal of waste on the territory of Slovenia and to the identification of potential areas for the disposal site.

The main product of spatial assessment is a map of the potential areas for the LILW disposal site. These areas were assessed by taking into consideration the suitability for both surface and underground disposal of LILW.

The map of potential areas was done in the GIS model, using the multi-parametric decision method of weighed sums. The results, presented on the map, will be valid for a longer period, because there are no indications of significant changes in the environment over a shorter period. At the same time, the map represents a basis for starting communication with the public and seeking agreement by the local communities.

Taking into account the necessity to inform the public, the Agency for Radwaste Management published the method and the results of spatial assessment, including the map of potential areas for disposing of LILW on the internet (Address: http://www.gov.si/arao/model/g_index.html).

Along with the map of potential areas for disposing of LILW, the Agency for Radwaste Management prepared an appropriate expert basis concerning the issue of LILW disposal, which will be part of the new national spatial plan, which is currently being prepared. The disposal of LILW is a facility of national interest, and it is therefore necessary for such a plan to be prepared within the established general frames of spatial planning processes.

6.5.2 ASSESSMENT OF PROPERTIES OF THE LILW STORAGE

The model-based assessment of properties of the low and intermediate waste disposal site shows how the disposal site behaves in natural conditions and what influences the facility may have on the people and the environment, especially in a long-term context. In 2001, the Agency for Radwaste Management started preparing such assessment for a prospective disposal site of LILW in Slovenia. As long as the site remains unknown, the assessment of the properties is built on the assumption that the most probable combination of geological environment and disposal facility are in place. As a starting-point, two already accomplished fundamental projects for the surface and the underground type of disposal have been considered, which were designed on an internationally acceptable concept. Radionuclide migration from the waste into the environment is prevented in both cases by a number of parallel barriers, made of concrete or other suitable backfill. It is assumed that the disposal will be intended for disposing of short-lived LILW with a small amount of long-lived ones within the prescribed levels. This would include the waste occurring at the Krško NPP during operation and future decommissioning, and waste from the Central Interim Storage for Radioactive Waste at Brinje.

Based on these assumptions and fundamental steps, physical and mathematical models have been made for the surface and the underground type of disposal of LILW, taking into account normal events and some of the most likely irregular circumstances within a few hundred years, after which period short-lived waste is no longer of any danger. The calculations done in 2001, which show migrations of radionuclides from the disposal to the human environment, were concentrated mainly on the vicinity of such a disposal site and on all the processes which can occur within this area. The possibility of using different kinds of covers for the disposal cells in the surface disposal was checked. The calculation results of the conditions in the vicinity of the disposal site were used for subsequent calculations of migrations of radionuclides in the geological environment and human environment. All performed calculations show that the influence of the disposal site on people, animals and the environment would be negligible and that the contribution of additional radiation above the closed disposal site would not differ from that of the natural background.

6.5.3 PRE-INVESTMENT DESIGN

Having in mind the need of construction of a LILW disposal, the Agency for Radwaste Management prepared a pre-investment design which provides total assessment of the investment for site selection and construction of the disposal site. The pre-investment design shows the planned activities in terms of both time schedule and costs. The financial aspect took into consideration two basic variants for constructing the disposal site; in the so-called ‘sensitivity analysis’ those factors are considered which significantly contribute to the costs of the investment. The design will be used as the basis for planning, assurance and sharing of financial means in the next several years.

7 EMERGENCY PREPAREDNESS

7.1 ADMINISTRATION FOR CIVIL PROTECTION AND DISASTER RELIEF OF THE RS

In 2001 the activities of the Administration for Civil Protection and Disaster Relief of the RS (ACDPRS), which is the authority responsible for civil protection, rescue and aid, and for the system of protection against natural and other disasters, were focused on the completion of the National Nuclear Emergency Response Plan (the National Plan). Concurrently the regional part of the National Plan was updated and matched to the plans at the municipal level. Finalisation and harmonisation of the plans was done as preparation for the national exercise in 2002 under the assumption of a severe accident in the Krško NPP. The focus was given to establishing and equipping the civil protection teams. The good co-operation with Croatia in the field of protection against natural and other disasters was intensified in 2001 with the information exchange on the status of emergency preparedness and with an agreement on the work of the subcommittee on harmonisation of the emergency plans.

7.1.1 NUCLEAR EMERGENCY PLANNING

In the area of planning the finalisation of annexes and supplements of the National Plan was under way. The activities comprised finalisation of the regional radiological emergency plan for the Posavje region and of the municipal plans of Krško, Brežice and Sevnica.

The Governmental »Working group for the co-ordination and maintenance of the state nuclear emergency response plan« held a meeting and concluded that the principal problem remained the same. This problem was inactivity of some ministries and state institutions which are co-responsible for the preparation of emergency plans. The activity of these organisations is vital in order to assure efficient emergency response. The group members took part in the preparation of the bases for the regional emergency plan and gave comments on the draft of the plan.

During the preparation of the National Plan at the regional level, the ACPDR actively participated. The ACPDR offered expert support in the preparation of the draft regional emergency plan, and it provided an interface with the ministries, state institutions and other regions supporting protective actions. During the year, also harmonisation meetings between the Krško NPP and the municipalities in the region of Posavje took place. The meetings were organised by the Krško Civil Protection Administration. The main aims of the meetings were to co-ordinate the plans, to exchange data and to finalise the plans at all levels. By the end of the year, the draft plans were written and the process of their approval had started.

7.1.2 ORGANISATION AND EQUIPMENT OF CIVIL PROTECTION TEAMS

In 2001 the purchase of the following equipment was planned:

- Probe for airborne radiation monitoring (label LPS, FZS), which will be connected to a radiation detector (label SSM-1, FZS). The detector had been supplied in the previous years. All these devices will be connected to a laptop computer and supported by appropriate software. The GPS will be integrated in order to provide exact position, which will be stored together with the dose rate in a numerical and graphical form.
- Meteorological kit for measurement of soil temperature, air temperature, humidity, wind speed and direction. The data supplied with such equipment are of great value in forecasting radioactive plume and deciding on evacuation.

The meteorological kit was supplied, but the supply of an airborne radiation monitoring probe was postponed to 2002 due to financial problems.

7.1.3 EDUCATION AND TRAINING OF CIVIL PROTECTION TEAMS

Regular training is conducted by the Civil Protection Training Centre at Ig near Ljubljana. In 2001, 84 persons were trained in different fields relating to nuclear and radiation accidents. The types of training and the number of participants are given in Table 7.1.

Table 7.1: Types of training and the number of participants in the Civil Protection Training Centre at Ig near Ljubljana.

Training	Number of participants
Additional training (ABC)* – for regions	58
Introductory and basic (ABC) – national units	15
Introductory and basic (ABC) - municipalities	8
Introductory and basic (ABC) - enterprises	3

*ABC - Atomic Biological Chemical Protection

7.2 SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

In 2001 the SNSA continued with the activities in the field of emergency preparedness, promoting its expertise in this field, ensuring implementation of international standards and stimulating other institutions to put more effort in the tasks relating to emergency preparedness.

7.2.1 THE SNSA EMERGENCY PLAN

In case of emergency, the SNSA activates the internal emergency plan (EP), which stipulates the notification of the staff and the specific organisational structure of the SNSA during an emergency, so that the SNSA can implement its tasks during an emergency. The EP procedures comprise, besides detailed instructions, the documents in relation with training and equipment lists. In 2001, 17 procedures were revised, which is about one half of the existing procedures.

The EP procedures cover the following six areas:

- internal organisation and responsibilities,
- notification and activation of the staff (especially experts from other organisations),
- accident assessment (instructions for the expert groups),
- informing (international organisations, foreign countries, the public),
- instructions for operation of equipment (computers, communication and other equipment),
- maintenance of preparedness.

All administrative tasks of the SNSA during an emergency are managed by three expert groups, which mostly consist of staff members of the SNSA, assisted by members of the technical support organisations. These three groups are:

- expert group for accident analysis,
- expert group for dose assessment,
- expert group for technical support and public information.

In 2001, the expert groups for accident analysis and for dose assessment increased the number of staff in each shift by one person, so that new members of the groups had to be recruited.

In the framework of the Quality Assurance Program of the SNSA, which requests a specific document structure, the SNSA began with adaptation of the EP as stipulated by the quality management system.

7.2.2 THE EXERCISE »NEK-2001«

On Saturday, 17 November 2001, the Krško NPP and the SNSA took part in the nuclear emergency exercise »NEK-2001«. During the exercise, the emergency preparedness of both participants was tested.

The scenario of the exercise was designed with an injury of the workers. There was no measurable radioactive release, but the danger of release was imminent in case of a containment failure. The participants could test the protective actions recommendations based on plant conditions instead of release. The nuclear power plant simulator was used, which provided the input for all activities. Other participants received the data via various communication means. The participants received information from the Krško NPP Technical Support Centre and from the »Emergency Off-site Facility« of the Krško NPP, located on the ACPDR premises in Ljubljana. The members of the »Emergency Off-site Facility« were employees of the Krško NPP who went to Ljubljana immediately after the declaration of the emergency. They had been waiting at home for the notification. After the »Emergency Off-site Facility« became operable, it took over the recommendation of protective actions, preparation of press releases and engineering support to the activities in the Krško NPP. The scenario was long enough, so that SNSA could test the expert groups and co-operation with the Meteorological Office, because during the exercise real weather conditions were used.

The exercise was organised in a short time period, therefore only the participants mentioned above took part. The main findings arrive at related to the necessity to improve the communication between the expert groups themselves, and to improve the forms and documents. The SNSA should be better prepared in case of increased media pressure, and a SNSA representative should be officially appointed to the »Emergency Off-site Facility« . The SNSA should also have a representative at the National Civil Protection Headquarters.

7.3 ECOLOGICAL LABORATORY WITH A MOBILE UNIT

The Ecological Laboratory with a Mobile Unit (ELMU) is operating at the JSI as the national unit of Civil Protection. Its duty is to perform complex radiological measurements, analyses and research. In 2001 the ELMU operated within the adopted working plan. In the framework of radiological activities, the ELMU took part in the annual »Programme of regular radiation surveillance around the Krško NPP«, which is required by decision of the SNSA.

In 2001 the ELMU intervened in two cases:

- when a sealed radioactive source was found in the Pivka scrap yard (July 2001). A report was written about the intervention: “Found Sealed Radioactive Source, Pivka, 19.7.2001 (JSI-DP-8458)”,
- during the removal of a radioactive lightning rod in Motel Grosuplje; two reports were written: “Remediation of the Area after Removal of a Lightning Rod with a Radioactive Source in Motel Grosuplje (JSI-DP-8487, October 2001) and “Dose Assessment during Non-authorised Removal of a Lightning Rod with a Radioactive Isotope in Motel Grosuplje (JSI-DP-8494, November 2001)”.

The description of these interventions is given in Chapter 5.6.

During 2001, the ELMU also carried out the following measurements and analyses:

- Radiological Surveillance during the Visit of Nuclear Submarine Norfolk in the Koper Port (JSI-DP-8389),
- Analysis of Radiological Conditions at the Cinkarna Celje Disposal Site (JSI-DP-8438).

The specific activities of the ELMU in relation with the nuclear and radiological emergency preparedness include:

- co-operation in the organisation of IAEA seminars and workshops in the area of emergency preparedness,
- co-operation in maintenance of the National plan,
- participation in activities of the IAEA on the development and writing of recommendations in the area of emergency preparedness and on the development of the system of quick assistance during emergencies.

The ELMU carried out three exercises in the Krško area with both vehicles and complete radiological equipment. These exercises are funded in accordance with the agreement between the ELMU and the Krško NPP. At every exercise, the programme of which is determined by the SNSA decision, the ELMU takes samples, performs measurements, carries out intercomparison measurements with the Radiation Protection section of the Krško NPP and has joint training with the power plant's mobile unit. During these exercises, the ELMU also visits the permanent measuring points (locations of aerosol and iodine pumps), measures the basic parameters (e.g. dose rate, surface contamination of filters with alpha and beta emitters, in-situ use of Ge detector), checks the procedures and the preparation of samples, and tests the measuring equipment. After each exercise a report is written, which is included in the comprehensive annual report "Measurement of Radioactivity around the Krško NPP".

The equipment of the ELMU is regularly maintained. The planned upgrading of radiological equipment was not completely implemented due to the lack of financial means. The development of the measuring system for on-line contamination recording in the moving vehicle is finished. The satellite navigation (GPS) enables vehicle position determination and the ionisation chamber measures the dose rate. The data are recorded in a database and displayed on a map of Slovenia (the Atlas of the Republic of Slovenia is used). Software for the detection, localisation and activity of sealed sources with the dose rate meter in the vehicle was developed.

It should be pointed out that the equipment of the ELMU needs substantial modernisation.

7.3.1 THE KRŠKO NPP

In 2001 the activities in the emergency planning in the Krško NPP were focused on the training of intervention workers and in the finalisation of the annual working plan activities. The priorities were: complete integration of the »Emergency Off-site Facility« into the emergency organisation, update of the computer equipment in the emergency organisation centres, integration of the simulator in training and exercises and modernisation of the emergency organisation activation system.

7.3.2 UPDATE OF THE RADIOLOGICAL EMERGENCY RESPONSE PLAN OF THE KRŠKO NPP (RERP)

During the regular revision of the existing procedures, three EIP (Emergency Implementing Procedures) were revised and two new procedures were written. The procedure "Notification List" had two revisions due to the changes of personnel in the organisational scheme.

7.3.3 PREMISES, EQUIPMENT AND SYSTEMS FOR ACCIDENT MANAGEMENT

In 2001 the Krško NPP upgraded the "Emergency Off-site Facility", which becomes operable at site emergency or general emergency. The "Emergency Off-site Facility" is located in the basement of the ACPDR building which is adjacent to the SNSA building. The data and communication links between the Krško NPP and the "Emergency Off-site Facility" were completed. In the "Emergency Off-site Facility" a modem was installed providing a link to the process-information system of the Krško NPP, an additional computer and office equipment was installed, documentation in the form of instruction books was provided and new wall maps for radiation monitoring were supplied. In the simulator room, additional telephone lines, needed for the exercise NEK-2001, were installed. Two workstations of the plant's internal process computer system were installed in the Technical Support Centre and the Operation Support Centre, but these workstations provide data from the simulator and are only used during exercises. Both workstations were tested during the exercise NEK-2001.

A more advanced system for notification of the emergency personnel was introduced. The old system, using ultra-short wavelength pagers, was replaced with an activation system based on cellular phones. In 2000, software for automatic notification of the emergency personnel was purchased. In 2001, the system was fully tested and commissioned. The system enables recording of response and availability of the notified personnel.

7.3.4 TRAINING, DRILLS AND EXERCISES

In 2001, the following training courses were organised in co-operation with the Krško NPP Training Unit:

- introductory and basic training of the emergency organisation personnel as scheduled in the annual plan (October 2001),
- training of the licensed personnel in the framework of annual retraining,
- training of the shift foremen (January 2001),
- training of the professional fire brigade personnel in compliance with the annual fire fighting training program,

In the framework of emergency preparedness, the following drills and activities were completed:

- drill of the professional fire brigade personnel and the Krško NPP professional and volunteer fire-fighting crew,
- drill of the radiological mobile unit together with the Ecological Laboratory with a Mobile Unit (ELMU),
- activation of the Krško NPP professional fire fighting crew (April 2001),
- activation of the Krško NPP emergency personnel (November 2001),
- monthly communication testing.

7.4 INTERNATIONAL ACTIVITIES

7.4.1 START OF THE IAEA PROJECT RER/9/064 »STRENGTHENING OF REGIONAL PREPAREDNESS AND RESPONSE FOR NUCLEAR EMERGENCIES«

The kick-off meeting of the IAEA project RER/9/064 »Strengthening of Regional Preparedness and Response for Nuclear Emergencies« took place in Budapest in October 2001. The countries participating in the project were: Armenia, Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Georgia, Iran, Kazakhstan, Latvia, Lithuania, Hungary, Malta, Moldavia, Poland, Romania, Slovakia, Slovenia, Turkey and Ukraine. Switzerland took part in the meeting as an observer.

The previous activities in relation to the project RER/9/064 were:

- drafting of the document of TECDOC type considering preparation, managing and evaluation of the exercises, a draft TECDOC document on informing the public, drafts of the Russian versions of TECDOCs, writing of a TECDOC referring to medical procedures,
- preparation of a new version of a software tool for dose assessment and protective actions planning, Interras 2.0,
- preparations for two regional workshops on procedures for emergency response. These two workshops are planned to take place in Ljubljana and Minsk,

- establishing co-operation with Project RER/9/056 “Upgrading of Radiological Protection Infrastructure” and with Project RER/9/065 “Development of Technical Capabilities for Sustainable Radiation and Waste Safety Infrastructure”.

One of the main goals of the participating countries in the RER/9/064 project was that each of the countries should organise at least one emergency exercise in 2002. The workshop on scenario preparation and exercise organisation was foreseen to be held in Vienna. In the workshop, the generic scenario will be given which could be used partially or completely at the exercise preparation. Some countries with nuclear programmes were more interested in organising the nuclear emergency exercise and they agreed it might be convenient to organise a regional exercise. Poland, Slovakia and Hungary planned to organise a joint exercise with the use of RODOS code. Croatia was interested to take part in an exercise involving the Krško NPP. Switzerland proposed an exercise with the scenario involving a lost source in the cross-border transport.

At the IAEA there is an Emergency Preparedness and Response Unit which develops the procedures of emergency response. This Unit runs the secretariat of the Inter-Agency Committee on the Response to Nuclear Accidents (IACRNA), which consists of representatives of EC, FAO, IAEA, OECD/NEA, WHO, WMO, UN-OCHA. The Joint Radiological Emergency Plan was developed, which defines responsibilities of each of the above organisations. The Unit maintains a web site where messages of the member states in relation to emergencies are sent. The Unit organises meetings of competent authorities responsible for early notification end exchange of information in the case of a nuclear or radiological accident.

Co-operation between the Republic of Slovenia and Republic of Croatia

In 2001 a Sub-Committee on Harmonisation of Emergency Plans was established. The Sub-Committee works in the framework of the Permanent Bilateral Committee for Implementation of the Agreement, i.e. the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Co-operation in the Area of Natural and Other Disasters. Slovenian members of the Sub-Committee are recruited from the regional Civil Protection Administrations bordering on Croatia, nuclear safety experts and ACPDR representatives. In October 2001, the first meeting of the Sub-Committee was held at the regional Civil Protection Training Centre at Ig near Ljubljana. The aim of the meeting was to discuss future work of the Sub-Committee and prioritisation with regard to harmonisation of emergency plans. The first priority was given to the nuclear emergency plan, which should be considered in detail during the next meeting, organised by Croatia. The ACPDR gave to Croatian representatives the last version of the Slovenian “National Nuclear Emergency Plan” as a support in preparing of their own emergency plan.

7.4.2 JINEX-2000 EXERCISE

The goals of the international JINEX-2000 exercise (Joint International Nuclear Emergency Exercise), taking place on 22.5.2001, were the following:

- information links and means of information between the participating countries,
- co-operation between the participating countries and international organisations,
- use and exchange of data from radiation monitoring networks,
- use of web technology (open or password protected) for public information,
- testing of the ECURIE system in EU countries and Switzerland and use of the regulations on restrictions for food import, and procedures on informing the other countries and the public,
- testing of the concept of managing and decision making during an emergency.

In Slovenia the participants were the SNSA, the National Civil Protection Commander, the Civil Protection Headquarters in operative structure, the ACPDR, and the representatives of the Ministry of Health, the Ministry of Environment and Spatial Planning, and the Ministry of

Agriculture. The exercise had a very slow pace, accurately simulating the real course of accident in the Gravelines NPP in France, which acted as an accident country. The contact points (the SNSA and the State Notification Centre) received the charts with air concentrations and radionuclide deposition (meteorological products) from the regional meteorological centres. In the exercise the National Nuclear Emergency Plan was tested for the case of the emergency occurring abroad. The main finding was that the chapter Notification and Alarming should be improved.

At the exercise, the third party liability in case of large radioactive contamination of neighbouring countries was also considered.

7.4.3 INTRODUCTION OF THE »RODOS« SYSTEM IN SLOVENIA

The RODOS (Real-time On-line Decision Support System) code enables optimisation of protective actions in the case of nuclear or radiological accidents. The code is aimed at decision-makers, who can optimise their decisions with real time data supplied by the RODOS. In 1999 the European Commission announced its intention to financially and technically support installation of the RODOS system in Slovenia. In 2001, Slovenia started with preparation of terms of reference which will be used to invite the tenders for the project of installation of the system.

The installation of RODOS in Slovenia is financed through a Phare programme. In 2001 the EC decided to introduce local managing of projects. That is why the initial project, which concerned installation of RODOS in Slovenia and the Czech Republic and maintenance of the existing systems in other countries, was split into several projects. The installation of RODOS in Slovenia was therefore a separate project led locally by the Slovenian Ministry of Finance and the Delegation of the EC in Ljubljana. At the end of 2001 the EC made a proposal to the SNSA to revise the terms of reference accordingly.

Two representatives of the SNSA participated in the RODOS Operators Courses which were held at Forschungszentrum in Karlsruhe, Germany, in March and December 2001.

7.4.4 DSSNET

On 27.-28.6.2001, a DSSNET (Decision Support Systems NETwork) meeting was organised in Ljubljana. In DSSNET, users of sophisticated decision support systems are joined, such as RODOS, developed in Germany, code Argos, developed in Denmark, the Japanese SPEEDI, and ARAC, developed in the USA. The experiences gained during JINEX-2000 and DSSNET exercises were presented. The participants presented the use of dispersion models in the case of non-radioactive substances propagation in gaseous or aquatic medium, e.g. in the case of foot-and-mouth disease dispersion. The virus of this disease is spread in the air as an aerosol due to coughing. Very interesting was the Japanese presentation of such models, predicting the migration of grasshopper swarms with the wind, predicting dispersion of smoke and gaseous volcano eruptions, and forecasting oil spills at tanker accidents.

7.4.5 ECURIE

The ECURIE system (European Community Urgent Radiological Information Exchange) was developed because of the need of the member states to have a communication system for the case of nuclear emergency operating around-the-clock. In the case of emergency, the system is capable of receiving initial notification, trigger the alarms and sending the information to the recipients. Slovenia still needs to sign a special agreement with the EC for ECURIE membership, and preparatory activities already started in 2001.

At the end of September, the EC communicated to the accession candidate countries the draft Agreement between the Euratom, the Candidate Countries and Switzerland in the framework of the ECURIE negotiations. The Agreement foresees that each ECURIE member state shall establish a system of coded messages exchange in the case of nuclear or radiation accidents (Coding/Decoding Software – CoDecS). The Agreement signature is expected in 2002.

In October 2001, a SNSA representative participated in the ECURIE meeting of the EU member states. The meeting was for the first time open to the candidate countries. The meeting participants exchanged experience in installation and operation of the network and the CoDecS software. This system was for the first time tested during a JINEX-2000 exercise, in May 2001.

In 2001 the SNSA purchased the communication and computer equipment which was needed for the operation of the CoDecS software. The necessary software for radiological data acquisition from other countries and for storage of Slovenian radiological data for the needs of countries was also installed.

7.4.6 EURDEP

EURDEP (the European Union Radioactivity Data Exchange Platform) is a system which stores radiological data collected from continuous external gamma monitoring. The system comprises the radiological data exchange among more than 20 European countries. The Joint Research Centre (JRC) in Ispra, Italy, maintains the system. The SNSA has been sending data to the EURDEP system since 1997. In 2001, the SNSA installed software for on-line European radiological data exchange, and a computer network which is connected to the Internet via ADSL telephone lines. Am important advantage of this novelty is a mandatory physical separation of this network from the governmental communication system HKOM, thus increasing the security of the communication system. The system enables reliable transfer (ftp) and data exchange in both directions, enabling access to data from abroad and vice-versa, access to Slovenian data in a foreign country. The mutual exchange of data between EURDEP and Slovenia is daily, but the frequency of exchange can easily be increased to a two-hour interval in the case of a nuclear accident. Switching to increased frequency of data sending was tested by the SNSA during the international JINEX-2000 exercise in May 2001.

8 SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

8.1 INTRODUCTION

The scope of competence of the SNSA is defined in Article 11, Paragraph 6 of the Act on Organisation and Competencies of Ministries (Off. Gaz. RS, No. 71/94, 47/97, 60/99 and 30/2001), as follows:

"The Slovenian Nuclear Safety Administration performs administrative and technical tasks related to:
- nuclear and radiation safety of nuclear facilities
- trade, transport and handling of nuclear and radioactive materials
- safeguards and inventory of radioactive materials
- physical protection of nuclear facilities and early notification in case of nuclear or radiation accidents
- liability for nuclear damage
- professional qualifications of operators of nuclear facilities and their training
- management of radioactive waste and spent fuel
- provision of radiation monitoring
- international co-operation in the field of administration and other tasks specified by regulations;
- supervision of laws and other rules and regulations governing the domain of nuclear safety."

In addition to the above Act, the legal basis for the administrative and professional tasks in the field of nuclear and radiation safety as well as inspection control of nuclear facilities is also provided by the Act on Government of the Republic of Slovenia (Off. Gaz. RS, No. 4/93, 23/96, 47/97 and 119/2000), the Act on Administration (Off. Gaz. RS, No. 67/94), the Act on Radiation Protection and Safe Use of Nuclear Energy (Off. Gaz. SFRY, No. 62/84) which is applied in the Republic of Slovenia on the basis of Article 4 of the Constitutional Act for the Implementation of the Basic Constitutional Charter on the Independence and Sovereignty of the Republic of Slovenia (Off. Gaz. RS, No. 1/91-I), the Act on Implementing Protection Against Ionising Radiation and Measures for the Safety of Nuclear Facilities (Off. Gaz. SRS, No. 82/80), the Act on Transport of Dangerous Goods (Off. Gaz. RS,79/99), the Decree on the Export and Import Regime of Specific Goods (Off. Gaz. RS, 17/99, 1/2000, 45/2000, 69/2000, 121/2000, 4/2001 and 15/2001) as well as rules and regulations based on the above acts, and the ratified and published international agreements in the field of nuclear energy and nuclear and radiation safety.

8.1.1 ORGANISATION SCHEME OF THE SNSA AND EMPLOYMENT POLICY

In the year 2001 nine persons were newly employed in the SNSA. Three of them were new additional employees and six were substitutions because one employee retired and five left by agreement. In consequence, on 1 January 2001 there were 41 employees at our Administration, and at the end of the year 2001 there were 44.
The applicable Rules of Internal Organisation and Job Systematisation of the SNSA envisages 47 permanent jobs. The organisation scheme of the SNSA is shown in Figure 8.1..

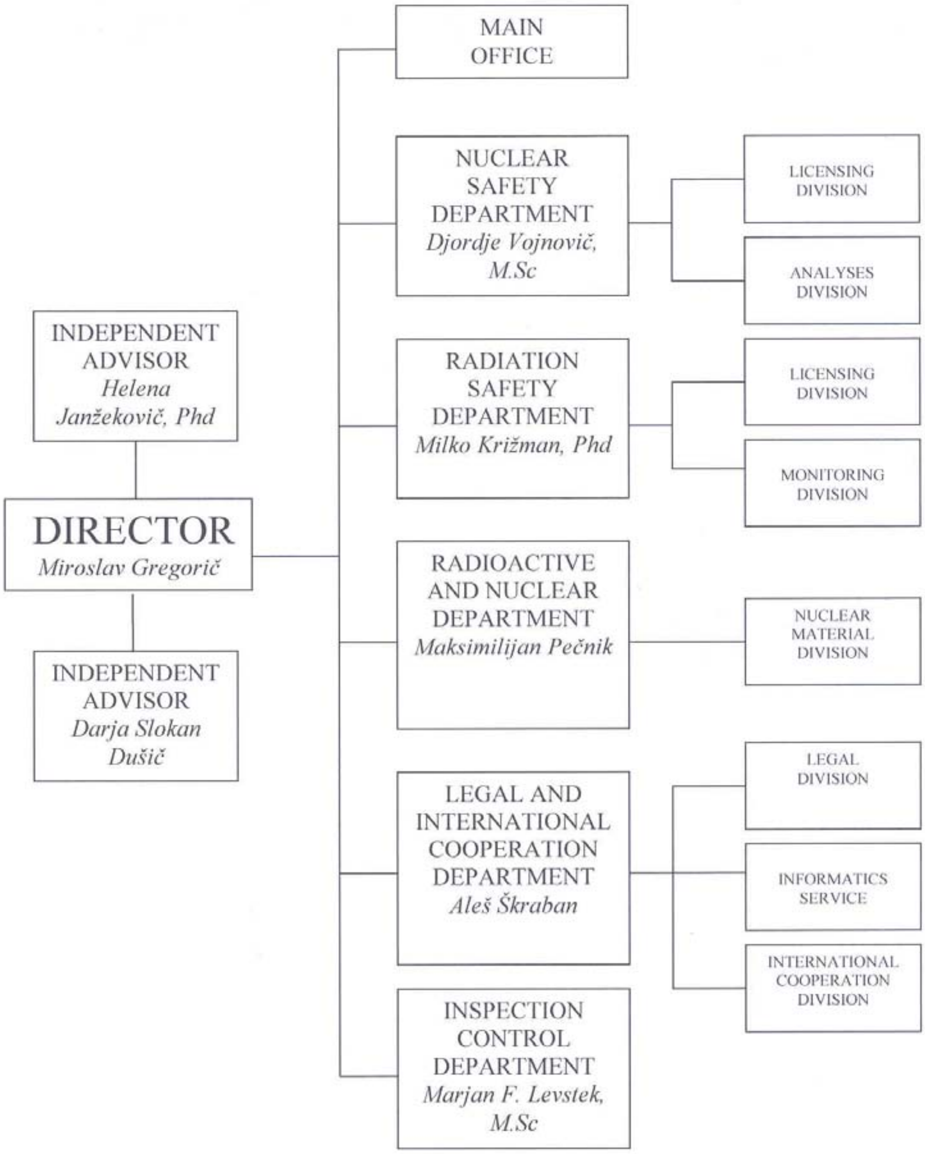

Figure 8.1: Organisation scheme of the SNSA.

The 44 employees had the following professional qualifications: there were 5 Doctors of Science, 13 Masters of Science, 22 University graduates, 1 employee with a College degree and 3 employees with Secondary education. Trend of employment at the SNSA (December 2001) is shown in Figure 8.2.

The structure of the employees on the last day of the year 2001 was as follows: the director, 33 senior civil servants, 6 civil servants, 4 members of technical staff.

In the year 2001, the SNSA endeavoured to secure, in accordance with the budgetary funds, as many experts as possible.

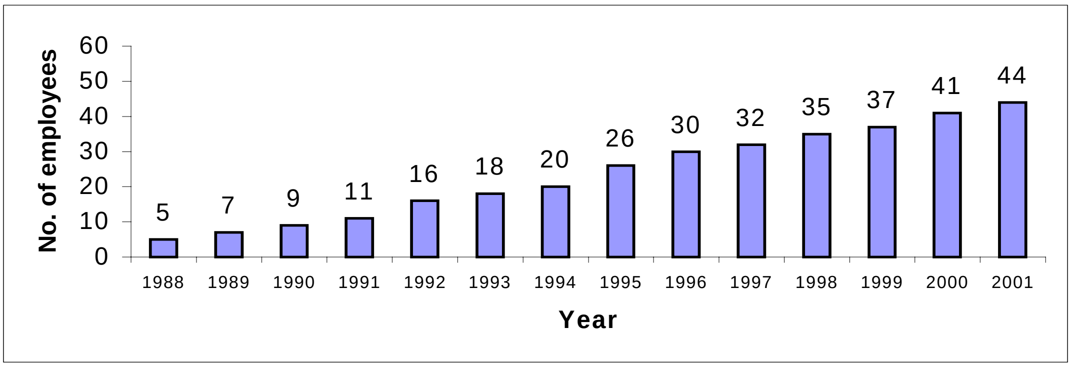

Figure 8.2: Trend of employment at the SNSA (December 2001).

8.1.2 EDUCATION AND TRAINING

In the year 2001 the SNSA paid particular attention to the professional training of its employees.

The Rules of Internal Organisation and Job Systematisation of the SNSA require that the employees pass the state exam which is a prerequisite for civil service. Out of 44 senior and junior civil servants and technical personnel, 35 have already passed the examination, while the remaining employees will pass it within one year after starting to work for the SNSA, as it is required by the State Employees Act.

All junior and senior civil servants have a working knowledge of a foreign language (English).

Nevertheless, a major part of the training was focused on nuclear safety and radiation protection. Several SNSA employees participated in special courses and passed the corresponding examinations within the scope of basic and advanced training programmes of the U.S. Nuclear Regulatory Commission, as well as the courses and examinations on the corresponding U.S. simulators (a copy of a nuclear power plant control room).

One of the employees completed a six-weeks' course in "Basics of Nuclear Technology" at the Milan Čopič Training Centre; four employees completed a course in "Radiation Protection II" and eleven employees completed a course in "Radiation Protection III".

Since work at the SNSA requires continuous development, a large part of training and education was carried out abroad. SNSA employees continued to participate in the international courses organised by IAEA, OECD/NEA and the European Commission.

The SNSA also stimulates off-the-job post-graduate studies. One employee studied public administration at the University of Ljubljana, the Faculty of Law.

Special emphasis was given to computer training, which helps the employees to become more efficient in their daily work.

8.1.3 THE BUDGET OF THE SNSA AND ITS REALISATION

The share of the assured means earmarked for the implementation of the program which is in the scope of competence of the SNSA in accordance with the Act on Organisation and Competencies of Ministries (Off. Gaz. RS, No. 71/94, 47/97, 60/99 and 30/2001) was only 31.64% of the budget for the year 2001. This represented 2.76 percentage points less than in the year 2000, when the share for the programs was 34.40% of the budget. Taking into account that the means for the implementation of programs in the amount of 129,456,000.00 SIT include the means for payment of IAEA and US NRC membership fees and a donation of the Government of Slovenia to the Chernobyl Shelter Fund, the residual means for the implementation of programs amounted to 49,228,000.00 SIT. A detailed survey of the SNSA's budget is given in Table 8.1. The planned program of work was realised in the frame of disposable means, which were insufficient. The budget of the SNSA failed to cover the budgetary items "Nuclear Safety" and "Radiological Safety".

As such, the budget of the SNSA is obviously not comparable to the budgets of similar regulatory bodies, competent in the field of nuclear and radiation safety in developed countries; it is not even comparable to the budgets of those candidates for EU membership which have nuclear programs (the Czech Republic, the Slovak Republic and Hungary). Such budget ranges the SNSA among the most insignificant budgetary users, which is clearly contrary to the established needs, supported also by the declarative obligation of the Republic of Slovenia to ensure and maintain a high level of nuclear safety in the country.

Table 8.1: The budget of the SNSA for 2001 and its comparison with the budget of the SNSA for 2000 (in 1000 SIT).

Purpose	Year	Adopted	Current	Consumption	Realisation in [%]
Wages	2000	174,301	185,666	184,516	99.38
	2001	228,792	228,792	228,074	99.69
Material Expenses	2000	25,414	25,414	25,078	98.68
	2001	27,129	27,249	23,557	86.45
Programs	2000	114,401	116,718	114,595	93.30
	2001	133,514	129,456	119,987	92.69
Investment	2000	11,912	11,912	11,577	97.00
	2001	19,692	23,630	22,038	93.26
Total	2000	326,028	339,710	335,767	97.09
	2001	409,127	409,127	393,654	96.22

8.2 LEGISLATION IN THE FIELD OF NUCLEAR SAFETY

8.2.1 LEGISLATION

Based on the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960 as amended by the Additional Protocol of 28th January 1964, and by the Protocol of 16th November 1982, the Government of the Republic of Slovenia adopted on 19 December 2001 a Decree on Establishment of the Amount of Limited Operator's Liability for Nuclear Damage

and on Establishment of the Amount of Insurance for Liability for Nuclear Damage (Off. Gaz. RS, 110/2001).
With this decree, the Government of the Republic of Slovenia determined:
- the amount of limited operator's liability for nuclear damage (150 million Special Drawing Rights - SDR)
- the amount of compulsory insurance for liability for the operator of a nuclear installation (150 million SDR), the amount of compulsory insurance for liability for the operator of a research reactor (5 million SDR) and the amount of compulsory insurance for liability for the carriage of nuclear substances (20 million SDR).

This decree derogates prior decree which had determined significant lower amount of operator's liability and of compulsory insurance for liability (42 million USD in SIT)

In 2001 SNSA continued with preparation of new law on nuclear and radiation safety. In April and May SNSA organised expert debate within the Nuclear Safety Expert Commission (also held in December 2000) where a draft new law was introduced. Afterwards an inter – departmental commission was appointed within the Ministry of Environment and Spatial Planning. Representatives of the SNSA and the Health Inspectorate of the Republic of Slovenia as well as other experts in the field of nuclear and radiation safety and representatives of nuclear and important radiation installations participated in the commission. The new law will be consistent with the demands of EU regulations in the field of radiation and nuclear safety and with the international agreements signed, ratified or succeeded by the Republic of Slovenia. Furthermore, the new law will be adjusted to the constitutional provisions (care of the state for healthy environment and determination of conditions for commercial and other activities), as well as to the provisions contained in the Act on Environmental Protection (Off. Gaz. RS, 32/93, 1/96) and in the regulations in the field of spatial planning, building, protection against natural and other disasters, physical protection and performing of public business services. The new law will contain the basic principles in the field of nuclear and radiation safety, provisions on performing practices, provisions on safety of people against ionising radiation, provisions on nuclear and radiation safety, provisions on licensing, provisions on extension, modification, withdrawal and expiration of license, provisions on non-proliferation of nuclear weapons and physical protection of nuclear installations and nuclear materials, provisions on monitoring, provisions on interventions in cases of radiological emergencies, provisions on nuclear and radiation safety reports, provisions on collecting data on sources and practices, provisions on financing nuclear and radiation safety, provisions on compensations for limited use of land, inspection provisions, penalty provisions and both interim and final provisions. It is foreseen that the draft law shall be read in governmental and parliamentary procedure in 2002 and shall enter into force by the end of 2002.
A draft new law also foresees the adoption of Governmental and ministerial regulations. Regulations should be issued in 9 and 18 months respectively after the law becomes effective. The law and the regulations together shall cover the whole subject of nuclear and radiation safety.

8.2.2 MULTILATERAL AGREEMENTS

In the year 2001 the following activities took place in the field of following multilateral agreements:

a) Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as amended by the Additional Protocol of 28 January 1964, and by the Protocol of 16 November 1982 (prepared in Paris on 29 July 1960, published in the Official Gaz. of the RS-IA, no. 18/2000, the so-called Paris Convention)

On 16 October 2001, Slovenia became a contracting party to the Paris Convention after all contracting states formally informed the depository of the convention, the Director General of the OECD (the Organisation for Economic Co-operation and Development), that they agree with Slovenia's accession to the convention. The event is of great importance for Slovenia, since this was the first time that a non-member of the OECD joined the Paris Convention for which the consent of all fourteen contacting states is requested.

The Paris Convention defines third party liability and its insurance. Together with the Brussels Supplementary Convention (see point b), it makes a complete system of liability and financial obligations of the operators, the state and the contracting parties in the case of nuclear damage.

Being a party to the Paris Convention and having formally applied to become a party to the Brussels Supplementary Convention, Slovenia on 9 November 2001 denounced the Vienna Convention on Civil Liability for Nuclear Damage (prepared in Vienna on 21 May 1963, published in the Off.Gaz. of the SFRY- IA, No. 5/77). Changing over from the Vienna to the Paris Convention assures a higher level of financial coverage in the case of an eventual nuclear accident.

b) Convention of 31 January 1963, Supplementary to the Paris Convention of 29 July 1960, as Amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982 (prepared in Brussels on 31 January 1963, published in the Official Gaz. of the RS-IA, No. 9/2001, the so-called Brussels Supplementary Convention)

On 5 April 2001 the Parliament of the Republic of Slovenia adopted a Law on Ratification of the Convention of 31 January 1963, Supplementary to the Paris Convention of 29 July 1960, as Amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982. On 6 December 2001 the Republic of Slovenia sent to the depository of the Brussels Supplementary Convention, the Ministry of Foreign Affairs of the Kingdom of Belgium, a diplomatic note to apply for accession to the convention since Slovenia fulfilled both conditions for the accession to the convention - closed internal legal procedure (ratification of the convention in the Parliament of the Republic of Slovenia and publication in the Official Gaz. of the RS-IA, no. 9/2001) and membership in the Paris Convention.

The Brussels Convention supplements the Paris Convention on Third Party Liability in the Field of Nuclear Energy. Both Conventions together make a complete system of liability and insurance for nuclear damage.

c) Convention on Physical Protection of Nuclear Material - amending procedure

From 3 to 7 December 2001 a meeting of an open-ended group of legal and technical experts was held in Vienna to prepare a draft amendment of the Convention on the Physical Protection of Nuclear Material. The group was convened by the Director General of the IAEA, to prepare the draft amendment in accordance with a recommendation of an expert group which discussed the need of the revision of the Convention on the Physical Protection of Nuclear Material. In the Final Report from May 2001 the group under the chairmanship of M. Gregorič concluded that there is "a clear need to strengthen the international physical protection regime" and that a spectrum of measures should be employed - including the drafting of a well-defined amendment to strengthen the Convention on the Physical Protection of Nuclear Material, to be reviewed by the States Parties with a view of determining if it should be submitted to an Amendment Conference (in accordance with Article 20 of the Convention). The convocation of the meeting was welcomed also by the IAEA's General Conference in resolution GC(45)/RES/14B. This decision was further referred to in the Report by the Director General to the Board of Governors (document GOV/2001/50). The amendment of the Convention on the Physical Protection of Nuclear Material is expected to:

- widen the scope of the convention (so that besides the physical protection of nuclear materials in international transport it will also arrange the physical protection of nuclear materials in domestic transport, storage and use as well as physical protection of nuclear installations and materials against sabotage);

- incorporate the fundamental principles of physical protection of nuclear installations and nuclear material;
- stress the importance of responsibility of the state for physical protection;
- stress the importance of protecting confidentiality of information related to nuclear material and nuclear installations;
- determine some new offences which should be included by the State Parties in their national laws.

d) Convention on Nuclear Safety

The Convention on Nuclear Safety (CNS), which is one of the most important international instruments of nuclear safety, entered into force on 24 September 1996. The Parliament of the Republic of Slovenia ratified the CNS on 20 November 1996 and it entered into force on 18 February 1997. The CNS has been ratified by 53 contracting parties. Among the states with nuclear power plants only Kazakhstan and India are not contracting parties of the CNS.

In accordance with Article 5 of the CNS, the SNSA prepared the Second National Report on Nuclear Safety together with the NPP Krško, the Institute Jožef Stefan, the Milan Čopič Nuclear Training Centre, the Administration for Civil Protection and Disaster Relief, the Health Inspectorate and the Agency for radioactive waste management. The National report includes the status with regard to implementation of the provisions of the CNS: the legal and regulation framework, the nuclear regulatory body, the financial and human resources, the human factor, quality assurance, assessment and verification of nuclear safety, radiation protection, emergency preparedness, the siting, the construction and the operating of the nuclear power plants.

The progress in the area of competencies of the nuclear regulatory body, the implementation of safety culture and the criteria of nuclear safety improvements prioritisation are described in a separate chapter at the end of the report. The national report was discussed at the 84th meeting of the Expert Commission for Nuclear Safety. It was then approved by the Slovenian government the 39th government meeting, where also the Slovene delegation was appointed for the Review meeting.

The national report was sent to the IAEA Secretary in October 2001. The IAEA ensured that all contracting parties received the national reports of all other contracting parties. Slovenia received 42 national reports from Argentina, Armenia, Australia, Austria, Belgium, Belarus, Bulgaria, Brazil, Cyprus, the Czech Republic, Chile, Finland, France, Greece, Croatia, Ireland, Japan, South Africa, Canada, China, Korea, Latvia, Lithuania, Luxembourg, Hungary, Mexico, Germany, the Netherlands, Norway, Pakistan, Peru, Poland, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine, Great Britain, the USA and EURATOM (the European Atomic Energy Community).

The national reports were reviewed. The additional questions and comments on reports were recorded and distributed to the country group co-ordinators and to the contracting parties directly. All questions should be replied by the time of the review meeting in Vienna (April 2002).

The Organisation Meeting should take place no later than 6 months before each Review Meeting in accordance with the Rules of Procedures of the CNS. The Organisation Meeting took place on 25-26 October 2001 in Vienna. The president of the Review Meeting and two vice-presidents were elected in accordance with the Rules of Procedures of the CNS. All contracting parties were divided into six country groups and the presidents, deputy presidents and reporters of each group were elected as well. Additionally, group co-ordinators responsible for the distribution of national reports, questions on the reports and answers were also appointed. The countries were divided in such a way that each group consisted of countries from different geographical regions and so that both those with and without nuclear facilities were represented in each group.

Mr. Miroslav Gregorič, Director of the SNSA, was elected President of the Review Meeting of the Contracting Parties**.** The Republic of Slovenia was ranged into country group number 5, together with the Russian Federation, Peru, Finland, Korea, Argentina, Mali, Croatia and Bangladesh. The president of the group was Mr. S. Collins, USA, the vice- president was Mr. S. Adamchik, Russian Federation, Mr. I. Valčič from Croatia was the co-ordinator, and Mr. P. Wigfull from Canada was the reporter of the group.

The Slovene second national report on the Convention on Nuclear Safety is available at the home page of the SNSA, under the Section Report - National Report, in both English and Slovene (http://www.gov.si/ursjv).

8.2.3 BILATERAL AGREEMENTS

In the year 2001 the Arrangement between the State Office for Nuclear Safety in the Czech Republic and the Slovenian Nuclear Safety Administration for the Exchange of Information (signed in Prague on 18 December 2000, published in the Off. Gaz. of the RS-IA, No. 22/2001) was ratified.

The Arrangement is based on the mutual interest of both regulatory bodies to exchange information relating to nuclear safety, safeguards, radwaste management, siting, building, operating and decommissioning of nuclear facilities. Besides information in the field of nuclear safety, the contracting parties shall exchange all other important information both for the experts and for the lay public of each country. The contracting parties shall exchange the information through letters, reports, other documents and through visits and meetings. The Arrangement has been signed for the period of 5 years and foresees the option to prolong the Arrangement.

8.3 INTERNATIONAL CO-OPERATION

8.3.1 CO-OPERATION WITH THE IAEA

8.3.1.1 General

The IAEA is an independent international organisation, established in 1957 by decision of the General Assembly of the United Nations Organisation. Among the functions of the IAEA, defined in the IAEA Statute, the following are included: to broaden and increase the contribution of nuclear energy to peace, health and progress in the world; to promote research and development in the field of peaceful use of nuclear energy; to exchange scientific and technical information; to establish and maintain control over nuclear materials; to prepare and adopt health and safety standards for the use of nuclear energy. Slovenia became a member of the IAEA in 1992.

8.3.1.2 General Conference

The 45th regular session of the General Conference, which is the highest representative body of the IAEA, was held in Vienna from 17 to 21 September 2001. There were 115 delegations from 134 member states, a large number of observer states and representatives of international and inter-governmental organisations. During the 45th session, Botswana and the Federal Republic of Yugoslavia became members of IAEA.

In his statement the Director General, Dr. Mohamed ElBaradei, presented a review of work done between the end of the 44th session and the 45th session of the General Conference. At the plenary session the delegations made their statements assessing the work of the IAEA and condemning the terrorist attacks on the USA of 11 September 2001. In parallel, most of the agenda expert items (non-political) were discussed by the Committee of the Whole.

The General Conference adopted with acclamation 28 resolutions and 2 presidential statements regarding the terrorist attacks on the USA and nuclear capabilities and threats of Israel. The adopted resolutions relate to: the membership of Botswana and the Federal Republic of Yugoslavia in the IAEA, reappointment of the Director General, Mohamed ElBaradei to a second four-year term, the IAEA's Accounts for 2000, the Agency's Budget for 2002, the IAEA's technical co-operation fund for 2002, the financing of Safeguards, rules regarding the acceptance of voluntary contributions of money to the IAEA, measures to strengthen international co-operation in nuclear, radiation, transport and waste safety, measures to strengthen the IAEA's technical co-operation activities, measures to strengthen the IAEA's activities related to nuclear science, technology and applications, strengthening the effectiveness and improving the efficiency of the safeguards system and application of the Model Protocol (adopted by a vote), measures to improve the security of nuclear materials and other radioactive materials, the personnel of the IAEA, appointment of the external auditor, implementation of the United Nations Security Council resolutions relating to Iraq (adopted by a vote), implementation of the agreement between the Agency and the Democratic People's Republic of Korea for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, and application of the Safeguards Agreement in the Middle East.

Within the adopted budget for 2002 in the amount of more than 245 Mio USD, the Republic of Slovenia contributes 33,286.00 USD and 141,179.00 EUR or 0.079% of the IAEA's entire budget, which means a 30% increased share of the Republic of Slovenia in comparison with the previous years and is based on the new scale of contributions according to the UN and the IAEA scale, respectively. The contribution of the Republic of Slovenia to the adopted Technical Co-operation Fund for 2002 (73 Mio USD) is 56,210.00 USD, i.e. 0.77% of the planned means.

The delegation of the Republic of Slovenia actively participated in parallel activities as well as in the work of the Committee of the Whole, which prepared proposals of most resolutions. The Slovenian delegation also took part as a co-proposer in adoption of six resolutions - also as an accession country to the EU.

In parallel with the General Conference, three expert meetings were held:
- the Fourth Scientific Forum, entitled Serving Human Needs: Nuclear Technology for Sustainable Development
- the senior regulators' meeting
- the Regional Meeting of European Member States Technical Co-operation,

where members of the Slovenian delegation also participated.

8.3.1.3 Board of Governors

The Board of Governors is a body which runs and directs the work of this specialised organisation within the UN between two sessions of the General Conference. The Board of Governors met eight times in 2001, five times as the Board of Governors, twice as the Programme and Budget Committee and once as the Technical Assistance and Co-operation Committee. To the extent that financial means and other working engagements allowed, the representatives of the SNSA participated in sessions of the Board of Governors (also in the sense of continuity of the Slovenian chairmanship from October 1998 to October 1999). Otherwise, the work of the Board of Governors was covered by the Embassy of the Republic of Slovenia in Vienna.

8.3.1.4 Technical Assistance and Co-operation

a) Meetings within the frame of the IAEA

In 2001 the IAEA organised a number of workshops, seminars, courses, conferences and symposia all over the world, 13 of them also in Slovenia, in co-operation with the JSI – the Milan Čopič Training Centre and the University of Ljubljana - the Faculty of Mathematics and Physics. The SNSA, as the contact point of the Republic of Slovenia for operational relations with the IAEA, was informing organisations in Slovenia about these meetings. Many Slovenian experts took an active part in the conferences and symposia by presentations. Slovenian experts also participated in numerous IAEA missions as expert specialists. On the whole, 75 Slovenian experts attended 137 of the above-mentioned workshops, seminars, courses, conferences and symposia in 2001.

b) Fellowships and Scientific Visits

Another area of the SNSA-IAEA collaboration within the scope of technical assistance and co-operation covers fellowships and scientific visits. In 2001, the IAEA submitted to Slovenia 33 applications for training of foreign experts in Slovenia. 13 of these applications (for either a fellowship or a scientific visit) were implemented in the same year. In 2001, 10 applications received already in 2000 were also implemented. 4 applications received in 2001 were rejected by Slovenia, 3 applications from 2001 and 2 applications from 2000 were cancelled by the IAEA. 13 applications for training received in 2001 are to be implemented in 2002.

The following training was implemented:

- Belarus, four one-month advanced study courses in the field of environmental protection and three one-month advanced training courses in the field of analytical chemistry;
- Bosnia and Herzegovina, two two-month advanced study courses in the field of radiation protection and one two-week advanced training course in the field of radiation protection;
- China, three one-day scientific visits in the field of reactor control;
- Ukraine, seven one-month advanced study courses in the filed of environmental protection;
- Syria, five one-month advanced study courses in the field of radiation protection;
- Tunisia, one three-month advanced training course in the field of nuclear electronics instrumentation; and
- Peru, two one-month advanced training courses in the field of isotope production.

The applications for training were addressed to the JSI, the University Medical Centre Ljubljana - the Department for Nuclear Medicine and the Institute of Oncology, the IOS and to the NPP Krško.

Training through fellowships and scientific visits is in most cases connected to a certain project of technical assistance. Within the framework of assistance for 2001, three Slovenian experts were trained in the Czech Republic in the field of use of positron emission tomography (PET), eight experts were trained one and two weeks in Belgium in the field of performance assessment for a LILW repository, one expert was trained for two weeks in the USA and the other for one week in Germany, both in the field of impacts of the Šoštanj fossil power plant and the NPP Krško on health of the general public and the environment.

c) Research Contracts

The programme of technical assistance and co-operation between Slovenia and the IAEA covers also the field of research contracts and the financing of major (national) projects.

In 2001, Slovenia submitted to the IAEA 6 new research contract proposals and 2 proposals for renewal of a research contract, prepared by the JSI, the National Institute of Biology of Ljubljana, the Institute for Mining, Geotechnology and Environment and the University Medical Centre Ljubljana - Department for Nuclear Medicine. In three cases the contract was renewed.

d) Projects of Technical Assistance

Technical assistance projects are the most extensive and the most demanding form of co-operation between the Republic of Slovenia and the IAEA. This is due to the large amount of resources, engagement of experts and also to the fact that projects of this type usually last for several years.

The IAEA is constantly trying to improve the field of technical co-operation with Member States, especially by endeavouring to allocate the funds earmarked for Member States within a particular project, to those areas where these funds are most needed. IAEA's efforts are directed also to permanent development of the areas mentioned above. For this reason, the IAEA formed a special mechanism, the so-called "Country Programme Framework" (CPF). The Country Programme Framework related to Slovenia states the development priorities of our country and will be considered when planning projects of technical assistance for the period 2000 - 2006: the long-term abandoning of the use of nuclear energy in a safe, ecological and economically acceptable way; maintaining of a high level of operational safety in the NPP Krško throughout the life of the NPP; assurance of reliable supply of energy; assurance of a high level of nuclear safety and disposability of the NPP, taking into account recommendations of international review missions.

During the 45th session of the General Conference there was a meeting of the European Regional Group of the Department of Technical Co-operation. The status of technical assistance projects and the programme of technical co-operation for the years 2003 - 2004 were presented. The focus of the presentations was on regional projects in the field of nuclear energy, a model project on radiation protection and the area of physical protection, as well as on the increasingly important area of security of nuclear materials. In addition, specific stress was placed on the presentations regarding the foundation of Regional Resources Centres and on the trends in the field of regional projects of technical assistance. In December 2001, the SNSA submitted to the IAEA 4 new project requests for assistance under the regular programme of technical co-operation and one request for the extension of the active model project, i.e.:

- "Development of Post-emergency Impact Assessment Capability", the main counterpart is the JSI;
- "High Energy Ion Microbeam Micromachining Tool", the main counterpart is the JSI;
- "Capacity Upgrade in Support to National and Regional Nutrition-pollution and Health Related Projects", the main counterpart is the JSI;
- "Isotope Hydrology in Dam Safety and Reservoir Leakage Problems", the main counterpart is the Institute for Mining, Geotechnology and Environment;
- "Performance Assessment for Low- and Intermediate-level Waste Repository", the main counterpart is the Agency for Radwaste Management (extension of the model project).

However, also some other projects, which started in 1999 and 2001, were being performed:

- "Facility for Cyclotron-produced Short-lived Medical Isotopes", the counterparts are the JSI, the University Medical Centre Ljubljana - Department for Nuclear Medicine and the Institute of Oncology, Ljubljana;
- "Performance Assessment for Low- and Intermediate-level Waste Repository", a model project, the main counterpart is the Agency for Radwaste Management;
- "Capacity Upgrade for Use of Environmental Isotopes as Natural Tracers" ("footnote a" project – the IAEA contributes a part of the means, the rest is contributed by sponsors), the main counterpart is the JSI;
- "Irradiation Facility for Industrial and Medical Sterilisation", the main counterpart is the JSI;
- "Comparing Health and Environmental Impacts of a TPP and an NPP", the main counterpart is the JSI;
- "Fast Pneumatic Transfer System for the TRIGA Mark II Reactor", the main counterpart is the JSI ("footnote a").

Within the regional programme projects for the period 2001 – 2002, institutions of the Republic of Slovenia participated in the following projects:

- RER/0/015 Legislative Assistance for the Utilisation of Nuclear Energy, participation of experts of the SNSA,
- RER/0/016 Human Resource Development and Nuclear Technology Support, participation of experts of the JSI and the SNSA,
- RER/0/021 Education and Training in Nuclear Sciences and Technology, participation of experts of the JSI,
- RER/1/005 Field Testing of Pulsed Neutron Generator for Demining, participation of experts of the JSI,
- RER/2/004 Quality Control and Quality Assurance of Nuclear Analytical Techniques, participation of experts of the JSI,
- RER/4/024 Improvement of Primary Circuit Component Integrity, participation of experts of the JSI, the NPP Krško, the Faculty of Mechanical Engineering, the Institute of Metals and Technology, the SNSA
- RER/4/025 Optimisation of NPP Performance and Service Life, participation of experts of the JSI, the NPP Krško and the SNSA,
- RER/5/011 Fertigation for Improved Crop Production and Environmental Protection, participation of the Institute of Hop Research and Brewing,
- RER/6/011 Thematic Programme on Nuclear Medicine, participation of the University Medical Centre Ljubljana - Department for Nuclear Medicine,
- RER/8/006 Radiation Treatment of Industrial and Municipal Waste, participation of experts of the JSI and Nova Gorica Polytechnic,
- RER/9/047 Capability for Assessment of Operational Safety of NPPs, participation of experts of the SNSA,
- RER/9/049 Medical Education for Nuclear Medicine Preparedness, participation of experts of the University Medical Centre Ljubljana - Department for Nuclear Medicine, the JSI, the Medical Centre Krško and the SNSA,
- RER/9/052 Nuclear Safety Regulatory Infrastructure, participation of experts of the SNSA,
- RER/9/060 Physical Protection and Security of Nuclear Materials, participation of experts of the Ministry of the Interior, the JSI, the University Medical Centre Ljubljana - Department for Nuclear Medicine and SNSA,
- RER/9/061 Enhancement of Nuclear Safety Regulatory Authority Effectiveness, participation of experts of the Health Inspectorate of the Republic of Slovenia and the SNSA,
- RER/9/063 Enhancing Occupational Radiation Protection in NPPs, participation of experts of the SNSA,
- RER/9/064 Harmonisation and Strengthening of Regional Preparedness and Response for Nuclear Emergencies, participation of experts of NPP Krško, Ministry of Defence and SNSA,

- RER/9/065 Development of Technical Capabilities for Sustainable Radiation and Waste Safety, participation of experts of the Žirovski Vrh Uranium Mine, the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, the Agency for Radwaste Management, the General Hospital of Maribor and the SNSA,
- RER/9/066 Strengthening Management of Operational Safety at NPPs and Utility Organisations, participation of experts of the JSI and the SNSA,
- RER/9/067 Application of Safety Assessment Methodologies for Near-surface Waste Disposal, participation of experts of the SNSA,
- RER/9/070 Strengthening Safety Assessment Capabilities of NPPs, participation of experts of the JSI, the NPP Krško, the Institute of Metal Constructions,
- RER/0/019 Sustainable Energy Options for Eastern Europe, participation of experts of the JSI, Milan Vidmar Electroinstitute and the Faculty of Mechanical Engineering of the University of Maribor,
- RER/0/018 Implications of Flexible Mechanism under the Kyoto Protocol for Europe, participation of experts of the JSI, Milan Vidmar Electroinstitute and the Faculty of Mechanical Engineering of the University of Maribor,
- RER/4/026 Upgrading Waste Processing Capacities at Centralised Facilities for Management of Radioactive Waste, participation of experts of the Agency for Radwaste Management, Geming, Ltd. and the SNSA,
- RER/6/012 QA/QC in Radiation Oncology, participation of experts of the Institute of Oncology,
- RER/9/062 National Regulatory Control and Occupational Radiation Protection Programme, participation of experts of the Health Inspectorate of the Republic of Slovenia, the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, the Institute for Occupational Health and the IOS.

8.3.1.5 IAEA Missions

a) Mission to Review the NPP Krško PSR Programme

From 23 to 26 April 2001 there was a mission of the IAEA at the Krško NPP entitled The Mission to Review the NPP Krško PSR Programme. The mission members reviewed the PSR programme that had been prepared by the NPP Krško. The programme was evaluated as an adequate basis for the PSR implementation. PSR is a Periodic Safety Review conducted as a rule every ten to fifteen years. The Krško NPP performs its first review of PSR. In 2002 the Krško NPP will be in commercial operation for twenty years. During this period there was a generation change of the personnel. The entire review of PSR will provide better documentation of the plant’s safety, complement the knowledge of younger staff at the plant and indirectly raise nuclear safety to a higher level.

b) The RAMP Mission

The IAEA Review of Accident Management Programme (RAMP) mission took place from 19 to 23 November 2001 at the NPP Krško. It was a pilot IAEA RAMP mission.

The RAMP mission was intended to review the overall *accident management programmes* - AMP. The objective of the mission was to review the comprehensiveness, consistency and quality of the overall AMP for the Krško NPP, including material and human resources for the AMP, the interrelation of the AMP with other plant activities, the emergency organisation and the qualification and training of the plant personnel. The mission gave a positive evaluation regarding the Krško NPP in the area covered by the mission's objectives. The mission found that the AMP for the Krško NPP had been successfully developed in accordance with the IAEA guidance documents as well as with international experience and practice. The mission identified as positive features the extensive involvement of the NPP staff in the AMP, the independent review by Westinghouse, and the availability of all documents related to AM through the NPP computer network. The use of a full-scope simulator in the SAM area in addition to the usual training tools was especially commended. The mission concluded its work with an exit meeting, and at the beginning of 2002 the mission report will be prepared.

c) ORPAS Mission

The IAEA Occupational Radiation Protection Appraisal Service (ORPAS) Mission took place from 2 to 6 July 2001 at the Slovenian Nuclear Safety Administration. Its aim was to assess the current situation regarding occupational exposure control in Slovenia. Within the scope of this aim, the mission members visited the following institutions: the JSI, the Department for Nuclear Medicine, the NPP Krško, the Institute of Oncology, the Institute of Radiology, the Slovenian National Building and Civil Engineering Institute and the Institute for Occupational Safety. Discussions were held with representatives of the SNSA and the Health Inspectorate of the Republic of Slovenia. Among the mission's essential and important recommendations are:

- the Republic of Slovenia urgently needs new legislation to reflect both the requirements of the IAEA BSS and the requirements of the relevant EU Directives,
- the Republic of Slovenia needs new mechanisms for introducing modern standards in laboratories performing personal dosimetry of workers as well as for calibration and testing services for instruments for measurement of physical quantities in the field of ionising radiation,
- the Republic of Slovenia needs new standards to be followed by institutions for training in the field of working with radiation sources,
- the secondary laboratory of the JSI should introduce new physical quantities in accordance with the ICRU standards and ISO 4037-1, -2 and –3,
- the Republic of Slovenia needs a national radioactive wastes repository,
- HIRS requires additional qualified inspectors if they are to adequately fulfil its mission,
- the Institute of Oncology requires additional qualified physicists, with particular reference to their patient care responsibilities,
- the new legislation of the Republic of Slovenia should place greater responsibility of the users for radiation protection and development of safety culture.

By the end of 2001 the mission had not submitted the final report.

8.3.2 CO-OPERATION WITH THE EUROPEAN UNION

8.3.2.1 Accession to the EU (Adoption of the Acquis communautaire)

In 2001 the SNSA continued with the harmonisation of the domestic legislation with the acquis communautaire. The Euratom Treaty is the fundamental document for all regulations in the area of nuclear safety and radiation protection in the EU. The Euratom Treaty, together with the regulations stipulated by it, forms the regulatory framework, which is binding for each Member State. This framework, which comprises nuclear safety, radiation protection, research, safeguards, supply, external relations and peaceful use of nuclear energy, is equally binding for the Candidate States and for the Member States.

a) Nuclear Energy

This area is considered in the 14^{th} Working Group "Energy". At the end of February 2001 the EU accepted the decision that no further negotiations were needed. However, the EU will continue to monitor the adoption and fulfilment of the Acquis through further negotiations.

The EU always underlines the importance of a high level of nuclear safety in Candidate States. In March 2001, the SNSA prepared a report for the need of the WPNS (Working Party on

Nuclear Safety), which had to prepare the Report on Nuclear Safety in the Candidate States. The report of the SNSA included:

- the important changes of the legal framework,
- the main findings of international missions and measures taken in the context of these findings,
- the latest results of deterministic and probabilistic safety analyses,
- data on the organisational structure of the nuclear power plant,
- data on completed modernisation works,
- seismicity of the Krško basin,
- data on the Research Reactor TRIGA MARK II,
- data on storage and strategy concerning low and high radioactive waste.

In June 2001, the Council of the EU discussed the Report on Nuclear Safety in the context of Enlargement (doc. 20536/01 CONF-SI 33/01), which was prepared by the WPNS. This report includes findings on conditions and possibilities concerning nuclear safety in each Candidate State as well as recommendations for improvements. In July the Commission forwarded these reports to the Candidate States. The Report introduces two types of recommendations: Type I Recommendations, defined as recommendations with the highest priority for consideration in the accession negotiations and Type II Recommendations, defined as recommendations for improvements and other necessary measures which should be implemented by the Candidate States, but in a more flexible time frame than Type I Recommendations.

Slovenia received one recommendation of Type I concerning nuclear legislation (conclusion of the on-going revision of the legislation) and three recommendations of Type II: completion of the activities related to the seismic characterisation of the Krško site, ensuring adequate resources for the regulatory body, and development of an integrated National Emergency Response Plan. Slovenia responded to these recommendations in its Report in October 2001.

b) Nuclear and Radiation Safety

This chapter is considered in the 22nd Working Group "Environment", and was temporarily closed in March 2001, since the domestic legislation was harmonised with the Acquis.

Within the frame of implementation of EU-related activities, a new Employment Plan was prepared for the year 2001, as well as a draft plan for the year 2002; both were prepared in January 2001. In accordance with this plan, the Ministry of Environment and Spatial Planning approved to the SNSA 10 new posts for 2001 and additional 9 posts for the year 2002. Since only 5 people were employed in 2001, the SNSA intends to employ more people in the year 2002, so as to comply with the EU legislation in the frame of competence of the SNSA.

Tables of Concordance (TOC) and Implementation Questionnaires (IQ) for 5 Directives were issued in April 2001; three of them in the area of radiation safety, one on public information in the case of a nuclear or radiological emergency, and one on transfer of radioactive waste. At the same time TOC/IQ were issued on transportation of radioactive material, on surveillance of import of contaminated foodstuff and feeding (taking into account the Chernobyl accident) and usage of contaminated foodstuff and feeding in the case of a nuclear emergency.

In organisation of TAIEX assistance an expert of RPII (Radiation Protection Institute of Ireland) visited Slovenia in the year 2001 to present Irish experience in transposition of EU radiation safety legislation in the Irish legal system and practise in connection with surveillance of radioactive sources, inspections and public and occupational exposure.

c) Other Activities in the Process of Accession to the EU

In April 2001, the 3rd meeting of the Association Committee EU-SI was held in Ljubljana. Various nuclear safety and nuclear energy matters were included in the meeting materials (operational aspects, seismicity of the Krško basin, radiation monitoring, fuel cycle, safeguards and measures against illicit trafficking of nuclear materials, radioactive waste management and early information exchange in the case of a radiation emergency).

In August and September 2001 a group of experts from the Translation Office of the Government Office for European Affairs, Government Office for Legislation and the SNSA reviewed the translation of the Euratom treaty.

In December 2001, nuclear issues were discussed during the Subcommittee Meeting on Transport, Energy, Environment and TENs in Ljubljana. The items on the agenda were: energy policy, response to the recommendations stated in the Report on Nuclear Safety in the context of Enlargement, PHARE projects and developments concerning international nuclear agreements. The discussion also covered modernisation of the Krško NPP and long-term solutions to the problems of spent fuel and nuclear waste.

8.3.2.2 The CONCERT Group

The CONCERT Group, formed in 1992, is a unique forum that brings together EU, CEEC and NIS nuclear regulators to share experience and to further the progress of assistance and co-operation activities in general. Among its other activities, this group advises DG Energy and Transport on corrective measures and guidelines for future work and promotes a high level of nuclear safety in all participating countries through exchange of regulatory experience and discussion of topical regulatory issues. In order to achieve its purposes the group convenes twice a year.

In the year 2001, the CONCERT Group convened three times, twice in Brussels and once in Budapest. The following topics were discussed: Quality Management of the Nuclear Regulatory Authorities, Maintaining Competence in NRA's and Regulatory Approach of the Nuclear Regulator. At all the meetings the participants reported on developments at the national level (legal framework, international co-operation, licensing and major events in nuclear installations). At the same time, the Reports on the work of NRWG and the Atomic Question Group (AQG) were presented.

8.3.2.3 NRWG

The NRWG is an EC advisory group that is made up of representatives of EU Member States and, in anticipation of their accession to the EU, representatives from candidate countries. Switzerland participates as an observer. Slovenia has been participating in the work of this group since 1998. The NRWG constitutes a forum for discussion to share experience on nuclear safety issues with the aim of achieving better harmonisation in practices and methods throughout Europe.

In 2001 two meetings of the NRWG were held. An important part of the meetings was devoted to reports and discussion on projects and studies in the area of nuclear safety, financed by the EC. The programme on future activities within the NRWG was also accepted.

A special session was held on risk-informed applications, with an emphasis on Risk-informed In-Service Inspection. The participants were representatives of the EC, regulatory authorities of EU Member and Candidate States, and some TSOs and nuclear power plant representatives co-operating in different projects.

The following activities and studies were also presented:
- Operational Safety, Task Force (TF) on Non-Destructive Qualification Programmes,
- Safety Management and Safety Culture; TF on Regulatory Assessment of the Effects of Economic Deregulation of the Nuclear Industry

- Study on 25 Years of Community Activities towards Harmonisation of Nuclear Safety Criteria and Requirements – Achievements and Prospects
- Study on European Safety Practices during Planned Outages at Nuclear Power Plants
- Co-operation with Candidate States in the context of Enlargement
- Activities of ENIS-G
- Project on Co-operation between Regulatory Authorities of the European Union and their Counterparts in the Applicant Countries of Central and Eastern Europe.

At every meeting a round table was held about events having potentially generic safety significance, including actions taken as a consequence of incidents in foreign countries.

8.3.2.4 ENIS-G

The European Nuclear Installation Safety Group (ENIS-G), which succeeded the Reactor Safety Working Group, was established with the purpose to strengthen the co-operation between EU Member and Candidate States. A meeting was held in January 2001 in Brussels to adopt the main documents for the functioning of the group as well as its composition. The participants discussed the report on nuclear safety in Candidate States, prepared by WENRA and a consortium under the guidance of the ENCONET enterprise. It was noticed that due to the reorganisation of the EC certain activities were not developing as expected.

8.3.2.5 ACCESS

In connection with the EU enlargement, the European Community is conducting the so-called ACCESS project (*Applicant Country Co-operation with Euratom Safeguards System*), which is intended for the Applicant Countries and whose main goal is to establish an automatic way of reporting to the EC office in Luxembourg from all EU holders of nuclear material. The EU invited in the 'Steering Committee' the representatives from the Applicant Countries. One representative from each country's regulatory authority which reports to the IAEA in accordance with IAEA safeguards.

In the frame of the ACCESS project, common computer software is being prepared, which will be implemented and tested in the Applicant Countries, and subsequently introduced in all EU Countries. The computer hardware and the program platform have been selected (Windows NT, Oracle, Java). The members of the Steering Committee have tested a module which enables creating of records on inventory changes (ICR). Representatives of the performers have promised that the software will be developed by the end of the third quarter of 2003. As the next step, nuclear power plant operators from those countries which participate in the ACCESS project will be trained.

8.3.2.6 ERWR

The European Radioactive Waste Regulator's Forum is an informal forum of representatives of regulatory authorities for nuclear and radioactive safety which deals with issues concerning radwaste management. The activities of the ERWR are co-ordinated by DG TREN. Slovenia was as an observer invited on its own initiative in 1999. The exchange of important information about current activities in the area of radwaste management in European countries is conducted through the ERWR.

The 6th ERWR meeting was held in Brussels. The main topics were:
- discussion on national reports of regulatory authorities and of the newly established Department of Nuclear Safety in DG TREN
- decision of the Finnish Parliament on the construction of a final repository of radwaste.

The participants agreed to invite as observers also all other EU Candidate States (at the time only Slovenia and Slovakia had this status).

8.3.3 CO-OPERATION WITH OTHER FORUMS

8.3.3.1 WENRA

At the end of the year 1998, nine nuclear regulatory bodies from EU Member States established a Western European Nuclear Regulators' Association (WENRA). The purpose of the association is to present an overall assessment of standards of nuclear safety in the founding countries as well as in EU Candidate States. One of the main activities is harmonisation of regulatory approaches on the basis of common safety criteria.

A two-day meeting was held in Paris in March 2001. Only the members of the association were invited to the first day of the meeting but these were later joined by directors from CEEC regulatory bodies. The participants continued with the discussion on reactions to the WENRA reports "Nuclear Safety in Candidate States". These reports were addressed to Governments, WENRA Members and the EC. The WENRA will present these reports to the EU Member States which do not have nuclear power plants. A discussion was also held on topics concerning bilateral and multilateral co-operation.

8.3.3.2 NERS

The Network of Regulators of Countries with Small Nuclear Programmes was established in September 1998 during the IAEA General Conference. It unites regulatory authorities for nuclear safety from countries with small nuclear power programmes facing similar problems. Their co-operation is thus aimed at exchanging information and knowledge in order to facilitate the problem-solving process.

The NERS Group held its fourth meeting in the South African Republic in October 2001. The In accordance with the agenda, the SNSA prepared the required documentation, which was forwarded to the organiser, but the representative of the SNSA could not attend the meeting.

8.3.3.3 INLA

In June 2001, an INLA (International Nuclear Law Association) Congress was held in Budapest, called Nuclear Inter Jura 2001. Nearly 200 lawyers and other experts from 41 states and international organisations covering the area of nuclear legislation participated in the congress hosted by the Hungarian Science Academy.

The congress covered several areas: licensing and safety, radiological safety, liability for nuclear damage and insurance for liability, and safe radwaste management. Sessions were held on topics of international nuclear trade and accession of Central and Eastern European Countries to the EU. The last session covered the subject of radioisotopes.

At the end of the congress, the General Assembly of the INLA elected new management. Mr. Rodney Elk from the South African Republic was elected as president. The next INLA congress will be held in the South African Republic in 2003. Slovenia was formally invited to organise an INLA conference in the year 2005 or 2006, and to nominate a representative to the Group for Safe Radwaste Management.

8.3.4 VISITS TO THE SNSA

In March 2001, Mr. Rodolf Cruz-Suarez from the IAEA visited the SNSA. The purpose of the meeting was to discuss the status of occupational exposure. It was agreed that in July the IAEA mission ORPAS would perform assessment of the system, organisation and performance of occupational exposure control in Slovenia.

At the same time, Mr. Josef Sabol from the IAEA paid a visit to the SNSA regarding the Regional Manager of Model Project RER/9/062. The main conclusion of the IAEA made on the basis of its missions performed in 16 countries was that national systems of occupational exposure control were not in harmony with the Basic Safety Standards. Mr. Sabol visited the Institute of Oncology, and met with a state secretary, Mr. Radovan Tavzes, from the Ministry of Environment and Spatial Planning, to present his observations on the situation concerning this issue in Slovenia.

At the end of March 2001, Mr. Derek Taylor, Head of the Radwaste Management Section in DG TREN visited the SNSA. The discussion was held on the topic of seismicity of the Krško NPP.

Mr. Massoud Samei, from the Department of Technical Co-operation, IAEA, paid a visit to the SNSA. He presented the field of technical co-operation and technical projects approved by the IAEA for the year 2001. During his stay, Mr. Samei also visited the Clinic for Nuclear Medicine, the Institute of Oncology and the JSI, and met with the Minister of health, Mr. Keber.

In May 2001, Mr. Marko Ninković, a representative of the Institute of Nuclear Science at Vinča visited the SNSA in order to re-establish co-operation in the nuclear field between the two institutions.

In the organisation of the Swedish Nuclear Power Inspectorate, a Ukrainian delegation visited Slovenia in June 2001. The delegation consisted of representatives of different ministries and parliamentary subcommittees in the regulatory authority for nuclear safety. The activities of the SNSA and other regulatory authorities in the filed of nuclear and radiological safety in Slovenia were presented and the guests were invited to visit the Krško NPP.

In September 2001, the SNSA and the JSI hosted a delegation of nuclear experts from Malaysia. The members of the delegation expressed a wish for further co-operation and exchange of experience, in particular with regard to activities at the Research Reactor TRIGA MARK II.

8.3.5 CO-OPERATION WITH OECD/NEA

In December 2000, the Republic of Slovenia sent an application to the NEA (Nuclear Energy Agency), which is an independent organisation within the OECD (Organisation for Economic Co-operation and Development), to become an observer in all standing technical committees. On 20 December 2001, the OECD Council decided to invite Slovenia to participate in these committees as an observer for 2002-2003. The Slovene Government intends to appoint permanent representatives of the Republic of Slovenia to all OECD subsidiary bodies in which it has the status of observer, participant or full participant, including NEA Committees.

a) OECD/NEA Meeting of the Nuclear Law Committee

The regular annual meeting of the Nuclear Law Committee was held in November 2001. two representatives of the Republic of Slovenia participated in the meeting as observers. The participants were informed about the course of exercise INEX (International Nuclear Exercise), which concerned issues relating to the implementation of provisions of the Paris Convention and the Brussels Supplementary Convention, such as national legislation provisions in the field of liability for nuclear damage. Some information was also provided about the first year of work of the International School of Nuclear Law, attended also by one representative of the SNSA. A report about the progress on the revision of the Paris and Brussels Conventions was presented, focusing on open issues of reciprocity, jurisdiction and terrorism-related provisions in the scheme of liability insurance.

b) OECD/NEA Meetings of the Committee on Safety of Nuclear Installations and of the Committee on Nuclear Regulatory Activities

In December 2001, the regular annual meetings of two NEA Committees, CSNI (Committee on Safety of Nuclear Installations) and CNRA (Committee on Nuclear Regulatory Activities) were held in Paris. The first one covers the field of safety of nuclear installations, and the second one deals with problems and activities of nuclear regulators. In the frame of the two Committees several working groups operate, with representatives from individual countries. The reports of the working groups with proposals for new projects were presented. Due to the events in the USA (11 September 2001), the NEA is trying to initiate a project on reviewing the existing methods relating to structural analysis in NPPs. The issue of safety standards was also raised.

In addition to participation in regular annual meetings of NEA Committees, representatives from the SNSA and from other Slovenian organisations also attended some workshops under NEA organisation, which were held in the Czech Republic, Switzerland and France.

8.3.6 BILATERAL CO-OPERATION

8.3.6.1 Hungary

The second regular meeting of the Slovenian and the Hungarian delegations based on the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Hungary for the Early Exchange of Information in the Event of a Radiological Emergency took place in Hungary in April 2001. On the Hungarian side, there were representatives of the Hungarian Atomic Energy Agency, led by its president Mr. Jozsef Ronaky, and representatives of the Paks NPP, the Ministry of Agriculture and Regional Development, the Ministry of Economic Relations, the Ministry of Environmental Protection, the Hungarian Academy of Sciences and the Nuclear Emergency Management Centre. On the Slovenian side, there were representatives from the SNSA, the Ministry of Economic Affairs and the Embassy of the Republic of Slovenia in Budapest. In addition to information exchange (in the field of legislation, accession to the EU, waste management, radiological monitoring and emergency planning), the Slovenian delegation visited the Paks NPP and the uranium mine in Mecsek, which is being closed down. Both sides agreed that the next meeting would be organised in Slovenia.

8.3.6.2 The Czech Republic

The first meeting under the Arrangement between the Slovenian Nuclear Safety Administration and the State Office for Nuclear Safety of the Czech Republic for the Exchange of Information was held in Slovenia in June 2001. In the Czech delegation there were representatives of the State Office for Nuclear Safety, led by its president Ms. Dana Drabova. In the Slovenian delegation there were representatives of the Slovenian Nuclear Safety Administration, the Ministry of Environment and Spatial Planning, the Ministry of Foreign Affairs, and the Administration for Civil Protection and Disaster Relief, led by the director of the SNSA, Mr. Miroslav Gregorič. The topics discussed during the meeting were: regulatory framework, overview of NPPs’ safety status, preparation of the second national report under the Convention on Nuclear Safety and EU enlargement. The Czech delegation also visited the Krško NPP. Both delegations agreed that the next meeting would be organised in the Czech Republic.

8.3.6.3 Croatia

The second meeting within the framework of the Agreement between the Republic of Slovenia and the Republic of Croatia for the Early Exchange of Information in the Event of a Radiological Emergency was held in November 2001 in Ljubljana. In the Slovenian delegation there were representatives of the SNSA, the MFA and the ACPDR. In the Croatian delegation there were representatives of the Ministry of Economy of the Republic of Croatia. The topics discussed during the meeting were: implementation of the agreement (method of exchange of information and co-operation in Krško NPP's exercises), international co-operation of the SNSA and the latest activities in the field of nuclear legislation in Slovenia. After the meeting the Croatian delegation attended a presentation of radiological monitoring and discussed issues concerning information exchange. Both sides expressed satisfaction with the achieved level of co-operation and willingness to co-operate even more closely.

8.3.6.4 The Slovak Republic

There was a second meeting based on the Agreement between the Government of the Republic of Slovenia and the Government of the Slovak Republic for the Exchange of the Information in the Field of Nuclear Safety in December 2001 in Bratislava. In the Slovak delegation there were representatives of the Nuclear regulatory authority of the Slovak Republic and representatives of the Ministry of Health, led by its president Mr. Miroslav Lipar. In the Slovenian delegation there were representatives of the Slovenian nuclear safety administration and Ms. Ada Filip Slivnik, the ambassadors of the Republic of Slovenia to the Slovak republic. The topics discussed were: legislation in the field of nuclear and radiation protection, status of NPPs in both countries, radioactive waste management, physical protection of nuclear installation, and emergency preparedness. The Slovak delegation invited Slovenian experts to visit the Radioactive Waste Treatment and Conditioning Centre at Bohunice. The next meeting will be held in the Republic of Slovenia in 2002.

8.3.6.5 Austria

The third meeting within the framework of the Agreement between the Republic of Slovenia and the Republic of Austria on the Exchange of Information in the case of a radiological emergency and on issues of common interest in the field of nuclear safety and radiation protection was held in Krško in December 2001. In the Slovenian delegation there were representatives of the SNSA, the ACPDR, the MFA, the Office for Energy, the NPP Krško and the Governmental Office for European Affairs. The Austrian delegation, led by Dr. Werner Druml, consisted of representatives of the Ministry of Foreign Affairs, the Government of the Carinthia Province, the Federal Agency for Environment, the Institute for Risk Research and the Ministry of Agriculture, Forestry, Environment and Water Management. After the visit of the Krško plant, the topics discussed during the meeting were: legislation framework, radiological monitoring, emergency preparedness, reconstruction of the spent fuel pit and severe accident management. Both delegations agreed that the next meeting would be organised in Austria.

8.4 PROVIDING PUBLIC INFORMATION

Safety culture is strongly related to the information. Radiation and nuclear safety must be under continuous surveillance by the public. Provision of open and authentic information to the public is a fundamental part of the policy of the SNSA. The SNSA endeavours to provide substantial and reliable information to the interested institutions, mass media and citizens through press conferences, public statements, media discussions, and active participation in domestic and international meetings, symposia and congresses, as well as through publications, the Internet and direct contacts with the interested public.

The Annual Report on Nuclear and Radiation Safety in 2000 was published in Poročevalec No. 71 (Reporter) - the publication of the National Assembly - on 6 September 2001, and is available in public libraries, as well as some specialised libraries, throughout Slovenia. It was also sent to all Ministries, mayors, journalists specialising in this professional field, some NGO's and Technical Support Organisations and seats of Nuclear Installations. The Annual Report on Nuclear and Radiation Safety in the Slovene language was sent also to the Slovene embassies abroad. The full text of the Annual Report on Nuclear and Radiation Safety in 2000 was also translated into English. The Report in English was sent to the permanent missions of States - Parties to the IAEA having representatives in the Board of Governors, to foreign regulatory authorities for nuclear and radiation safety and to foreign organisations in the nuclear and radiation field. The Report (both the Slovene and the English version) is also available on the Internet (http://www.gov.si/ursjv).

Besides the Annual Reports on Nuclear and Radiation Safety in the Republic of Slovenia several other topics can also be found on the SNSA Internet site: basic information on the SNSA (mission, contacts, organisational chart, scope of competence), EU legislation in the field of nuclear and radiation safety, international agreements, IAEA Standards, IAEA announcements (research contracts, meetings, workshops), on-line radiological monitoring, National Reports on Fulfilment of the Obligations of the Convention on Nuclear Safety, expert missions reports, INES events, information on annual outage of the NPP Krško, the SNSA library, public statements, the latest news and events and links to other sites of foreign regulatory authorities, organisations, research centres, etc.

In case of important event SNSA (as for instance adoption of the Annual Report on Nuclear and Radiation safety in 2000, admission of Slovenia as observer to the OECD/NEA, accession of Slovenia to Paris Convention on Third Party Liability in the Field of Nuclear Energy) organised press conferences or participated at them.

Reports on SNSA activities are also published in the bulletin 'Okolje in prostor' (Environment and Physical Planning), published by the Ministry of Environment, Physical Planning and Energy. The SNSA regularly contributes articles on courses, seminars and symposia attended at home and abroad. The articles are intended to give basic information on training and the names of contact persons to provide additional information on certain topics to those who are interested.

In 2001, the SNSA continued sending data to the international network in the field of nuclear and radiation safety NucNet and distributed the NucNet data to the interested media in Slovenia. The NucNet – The World's Nuclear News Agency - was established in 1991 as an information source to all interested in information on the most recent activities in the field of atomic energy. It receives data from nuclear facilities, competent regulatory authorities for their surveillance, ministries, and research centres from more than 40 countries. Every year the SNSA, the distributor for Slovenia, investigates the interest of media and others in this information and updates the list of the receivers.

All research work and studies financed by the SNSA are public and available at the SNSA Library, and the international missions' reports are available on the SNSA's Internet pages and at the National and University Library, the Central Technical Library (both in Ljubljana), and at the University Library, Maribor.

8.4.1 SPECIAL SNSA LIBRARY

The main goals of the library of the SNSA are: ordering, gathering and loan of books and magazines, searching through local and international databases, monthly notification about new publications.

The library maintains a bibliographic database currently containing over 7,000 indexed records (monographic and serial publications, work reports, non-book material, ...) in the fields of physics (nuclear safety, radiation safety, radioactive materials and waste, environment impact, peaceful use of nuclear energy, non-proliferation of nuclear weapons), mechanical engineering, nuclear technology, chemistry, medicine, biology, computer and information science, geology and law. Most of the library material is catalogued in the COBISS (Co-operative online bibliographic system and services) system, so the users can search through SNSA web pages.

The main goal of the SNSA is to enable access to library materials for a wide audience and to bring these materials nearer to the general public. On the SNSA web pages we therefore started to offer information about the library and its collection, and we monthly publish a list of new books and magazines. Users can also apply for inter-library loans of publications.

8.5 EXPERT COMMISSIONS

8.5.1 NUCLEAR SAFETY EXPERT COMMISSION (NSEC)

The Nuclear Safety Expert Commission (NSEC), which has an advisory role to the SNSA, met five times in 2001. It is composed of 22 members, 10 of whom are officials from ministries and 12 experts on nuclear and radiation safety. Its scope of work is defined in the Act on Implementing Protection against Ionising Radiation and Measures for the Safety of Nuclear Facilities (Off. Gaz. SRS, 28/80) and in its Rules of Procedure.

In addition to the standard issue, i.e. "safety of nuclear facilities operation in the period after the last meeting", the NSEC also discussed the following issues in 2001:

- report on preparations for the 2001 outage at the Krško NPP,
- report on preparation of new legislation in the field of nuclear and radiation safety,
- proposal of appointment of ad-hoc working groups of NSEC to prepare executive regulations,
- presentation of the outlines of the new nuclear and radiation safety law,
- report on nuclear and radiation safety in the Republic of Slovenia in 2000,
- second National Report on Fulfilment of the Obligations of the Convention on Nuclear Safety,
- report on the 2001 outage at the Krško NPP,
- report on modernisation of the Central depository for radwaste at Brinje,
- reports of ad-hoc working groups of NSEC to prepare executive regulations,
- renewal and broadening of authorisation of the Slovenian National Civil Engineering Institute.

8.5.2 EXPERT COMMISSION FOR TESTING NPP KRŠKO OPERATORS QUALIFICATIONS (ECTPQ)

In the year 2001, the Expert Commission for testing of NPP Krško operators’ qualifications (ECTPQ) held three meetings. Two of them were on various topics relating to operators testing, and the third concerned organisation and testing of NPP Krško operators’ knowledge.

In the year 2001, the ECTPQ organised two examinations in the autumn period (November and December) for 11 candidates. The Examination for Senior Reactor Operator was passed by 9 candidates, with one candidate acquiring the license for the first time and the other 8 extending their licenses. Two candidates passed successfully the training for the extension of the Reactor Operator license.

The SNSA extended licenses to all candidates who successfully passed the examinations in accordance with the proposal of the ECTPQ: licenses were thus given for 1 year to the candidates who passed the examination for the first time, and extended for 4 years for the others. License for the Reactor Operator was extended in the accordance with the proposal of the ECTPQ for 2 years for one candidate and for 1 year for the other.

8.6 RESEARCH PROJECTS AND STUDIES

a) Study with proposals of solutions for the draft law on nuclear and radiation safety - provisions on the public agency and financing of the activities covered by the draft law (Institute for Public Administration at the Faculty of Law, University of Ljubljana)

The study was prepared by the Institute for Public Administration, Faculty of Law, University of Ljubljana, which was selected on the basis of a procedure determined in the Directive on orders of minor values No. 402-00-67/00, dated 3 January 2001 and 18 May 2001. The study treats the proposed solutions of the draft law on nuclear and radiation safety, namely the provisions on the public agency and financing of the activities covered by the draft law. In its first part the study deals with reasons for independent regulation, different aspects of independence of public agencies (organisational, functional, personal, financial and legal) and reasons for and against independence of regulations in the field of nuclear safety. In its second part the study deals with the question of fees – the possibility that the law would confer authority to fix fees, conditions for such conferment and the possibility of fixing fees with a general act of the agency. In its third part the study deals with the provisions of the draft law related to the agency and fees, and finally some changes in the wording of the draft law are proposed, namely slightly changed provisions relating to the agency and the fees.

b) Geotectonic Research for Safety Assessment (Geological Survey, Slovenia)

In the year 2001, the geological mapping of the western part of the Krško basin was continued by the methodology of mapping all outcrops in the scale of 1:5000. The mapping was carried out on an area of 25 km^2 and represented the last step in the project, carried out between 1996 and 2001. The data will be used for the building of a new seismotectonic model which will serve as an input to the changes of the NPP Krško safety report and to the review of probability assessment of seismic risk at the location of the NPP.

8.7 QUALITY MANAGEMENT SYSTEM

In 2001, the SNSA started to systematically upgrade the quality management system, since the development of quality management (QM) is becoming an important issue for the public administration. This is evident from the Slovenian Government strategic directives and aims for the year 2001 and the following years. On the other hand, also the IAEA recommends introduction of such a system. For this purpose, in 1999, the IAEA published TECDOC -1090 "Quality assurance within regulatory bodies"

With the introduction and implementation of the QM system the SNSA intends to :
- increase clients' satisfaction and public confidence
- increase employees' satisfaction
- improve efficiency and effectiveness
- reduce costs
- improve the organisation's transparency
- increase public reputation and recognition

The QM system is being brought into force through the Project Team and the Quality Board.

The role of the Quality Board is mainly to ensure the development and the implementation of the QM system and continuous improvement of its effectiveness. The role of the Project Team is to establish, document and introduce the QM system. Simultaneously, the internal regulations define that every SNSA employee is responsible for the implementation, maintaining and improvement of the QM system within the scope of his/her activities.

The SNSA is developing the quality management system in accordance with the International Standard ISO 9001: 2000 "Quality management systems - Requirements", IAEA Safety Series No. 50-C/SG-Q; January 2001 and the IAEA-TECDOC-1090: "Quality Assurance within Regulatory Bodies"; June 1999, taking into account also other documents referring to nuclear quality management.

Sources

- Standard SIST ISO 9001, December 2000; Quality management systems - Requirements ISO/TR 10013, Technical Report, Guidelines for quality management system documentation"
- IAEA TECDOC - 1090, Quality assurance within regulatory bodies, Vienna, 1999.
- IAEA Safety Series No.50-C/SG-Q, Quality assurance for safety in nuclear power plants and other nuclear installations; Code and Safety Guides Q1- Q14, Vienna, 2001
- G. Žurga, "Management excellence as a means to achieve efficiency in public administration", Consultation: A way to management excellence, Ljubljana, Slovenia, May 30 2001, Ministry of the Interior, 2001, pp. 29-39.

9 TECHNICAL SUPPORT ORGANISATIONS

According to Article 14 of the Act on Implementing Protection against Ionising Radiation and Measures for the Safety of Nuclear Facilities (Off. Gaz. SRS, No. 28/80), technical and research organisations were authorised by a decision of the Committee for Energy, Industry and Construction of the Republic of Slovenia (RS), or by the SNSA as its legal successor, to perform specific tasks within the scope of their activities and qualifications in the field of nuclear and radiation safety in the Republic of Slovenia. The conditions and the time schedules for performing their tasks are laid down in the "Rules on Methods and Terms of Record-keeping, Reporting on Nuclear Safety to the RS Inspectorate of Energy by Organisations in the Field of Nuclear Safety and by Organisations Operating Nuclear Facilities and Installations, and Methods and Terms of Exchange of Information" (Off. Gaz. SRS, No. 12/81).

9.1 MILAN VIDMAR ELECTROINSTITUTE

According to the decision of the Committee of RS for Energy, Industry and Construction No. 31.10-034/80, of 8 December 1980, the Milan Vidmar Electroinstitute (EIMV) is authorised for the following tasks relating to construction, trial operation, start-up and operation of nuclear facilities and installations:

- quality assurance, performance of measurements of electric equipment, low and high voltage electric circuits and installation during the construction, trial operation and operation of nuclear facilities,
- verification of operability, reliability and quality of the systems for control and automation of nuclear facilities and installations,
- training of technical staff in the above-mentioned areas,
- performance of acceptance tests on the electric equipment.

In 2001 the activities of the EIMV related to the nuclear safety were as follows:

a. Activities during the regular annual outage and refuelling in the Krško NPP

During the regular annual outage and refuelling in 2001, the EIMV carried out all the required measurements and controls on high voltage electric components and systems in accordance with the Krško NPP program. During the regular annual outage, the EIMV followed the performance of revisions and inspections of electric systems and components of all voltage levels and co-ordinated authorised technical support organisations supervising the outage activities and refuelling. After the Outage 2000 was completed, the EIMV compiled, on the basis of individual expert reports, the "Joint Expert Assessment Report on the Outage Activities, Interventions and Tests during the Shutdown of the Krško NPP for the Refuelling at the End of the 17th Fuel Cycle".

b. Representatives of the EIMV were members of the Expert Group for the Analysis of Accidents and of the Commission for Operators Exams working under the auspices of the SNSA.

c. The research projects relating to nuclear energy focused on the qualification of the electric equipment and on the analysis of the service loads of the Krško NPP.

9.2 ENCONET

ENCONET Consulting Ges. m. b. H., Auhofstrasse 58, A-1130 Vienna, Austria, was by decision no. 318-55/95-14126/ML, issued by the SNSA on 19 March 1997, authorised for the following tasks and services in the field of nuclear safety on the territory of the Republic of Slovenia:

- safety assessment and review of the reports and other documentation related to nuclear safety,
- safety analysis as a support to the regulatory body for nuclear safety in the licensing process.

In Slovenia ENCONET activities focused on completion of the independent evaluation of the analyses related to NPP Krško (NEK) modernisation and steam generators replacement (SGR) and initiation of the PSR review.

With regard to the steam generators replacement and power uprate for NEK, ENCONET performed an independent evaluation of Packages C and D2, System evaluation and Snubber reduction. This work started in 1998. In 2001, the remaining reviews of Package D were completed.

In 2001 the Program of PSR for NEK was completed in collaboration between NEK and ENCONET. Upon approval by the SNSA, this served as the basis for issuance of an invitation to tender for several packages within the PSR program.

9.3 FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING, UNIVERSITY OF ZAGREB

The Faculty of Electrical Engineering and Computing, University of Zagreb (FER), was by decision no. 318-38/90-1413/AS, issued by the SNSA on 2 April 1991, authorised for the following tasks and services in the field of nuclear safety on the territory of the Republic of Slovenia:
- safety analysis of installations, components and systems of nuclear facilities,
- safety analysis for qualification of safety class electric equipment.

In 2001, FER focused on three major areas: the first one related to NEK operation, the second to educational activities in co-operation with the IAEA and the third was participation in the development of a new reactor concept. The activities relating to NEK operation covered areas of safety analyses, expert reviews and assessments, and in-core fuel management.

As an authorised organisation FER evaluated the Containment Leak Rate Test (CLRT) program changes due to implementation of performance-based requirements from Appendix J of 10 CFR 50. As part of this activity, a Final Expert Evaluation Report was published.

In the year 2001 FER continued educational activity in co-operation with the IAEA. As part of this program a number of IAEA fellows passed fellowship programs and carried out scientific visits.

9.4 FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF LJUBLJANA

The Faculty of Mechanical Engineering, University of Ljubljana (FS), was authorised by decision of the Committee of RS for Energy, Industry and Construction No. 31.10-034/80, of 8 December 1980, for the following:
- quality assurance and control of mechanical equipment in nuclear facilities and installations during production, installation, pre-operational tests, trial operation and operation of a nuclear facility,

- testing, measurements and operability control of measuring systems, regulation and mechanical equipment operation in a nuclear facility,
- measurements, quality control and operability control of ventilation systems and heating, cooling and air-conditioning systems in a nuclear facility,
- measurements, testing and operability control of mechanical installations and emergency power supply systems,
- acceptance testing of mechanical equipment,
- training of technical staff in the above mentioned areas.

Within the frame of the Milan Vidmar Electrical Institute, FS participated as an authorised organisation in the annual outage activities in the Krško NPP from 9 May to 19 June. The activities of the Faculty comprised testing of the steam turbine with subsystems and the auxiliary steam turbine. The Final Report of the Faculty of Mechanical Engineering on the outage was submitted to the Milan Vidmar Electrical Institute on 17 July 2001.

The Faculty was contracted by the Krško NPP to participate in the Plant Performance Test and to perform measurements of the yield of the plant after the modernisation and the replacement of the steam generators. The presentation of results and technical discussion about possible improvements was concluded in the spring of 2001.

A representative of the Faculty was participating as a member in the Expert commission on nuclear safety within the SNSA.

9.5 IBE CONSULTING ENGINEERS

The IBE Consulting Engineers (IBE), Ljubljana, is authorised for the following (decision of the Committee of RS for Energy, Industry and Construction of 8 December 1980, Off. Gaz. SRS, No. 32/1980):
- preparation of investment and technical documentation for nuclear facilities,
- organisation of construction of nuclear facilities and installations and surveillance during construction, pre-operational tests and trial operation, including organisation of quality assurance in nuclear facilities and installations during the construction,
- control of investment and technical documentation for nuclear facilities and installations,
- preparation of physical plans and siting documentation.

In 2001 IBE was preparing for NEK project documentation for construction, modification packages and As Built documentation, in mechanical, civil engineering, architectural and electrical fields. IBE was also performing technical-geodetic observation of key buildings and keeping a register of the observations.

For the decommissioning of the Mine Žirovski Vrh, IBE prepared a design package for dismantling the rest of the structures and their remediation, and a design package for the final disposition of the ore processing site - for the mine waste dump Jazbec and for the milling waste Boršt.

Within the scope of the project Siting for Low and Intermediate Level Waste Repository - Evaluation of Environmental Properties, which was prepared by IBE as a subcontractor of the Slovenian Geological Survey for ARAO, a set of non-geological criteria for evaluation of the space and assessment of its vulnerability was prepared.

IBE supervised the restoration of the Central Radwaste Storage at Brinje (contracted by the SNSA).

9.6 JOŽEF STEFAN INSTITUTE

By decision No. 31.10-034/80, issued by the Committee of RS for Energy, Industry and Construction on 8 December 1980, the JSI, Ljubljana, was authorised to carry out the following activities on the territory of the Republic of Slovenia:
- analysis of events in nuclear facilities,
- reviewing the results of siting investigations for nuclear facilities,
- analysis of unusual events in nuclear facilities,
- verification of the operational status of the safety systems in a nuclear facility and of physical security,
- testing, measurements and verification of operability of nuclear, in-core and radiological instrumentation, and of the reactor control system,
- nostrification and review of the safety report,
- verification of test results of the safety systems during trial operation,
- preparation and execution of emergency measures during an accident related to radiation protection, marking the contaminated areas and decontamination and assessment of the risk to the environment,
- training of workers in the basics of reactor technology, description of nuclear power plant systems, and radiation protection,
- activities in the field of radiation protection according to the Act on radiation protection,
- systematic monitoring of contamination of food and environment with radioactive substances,
- dosimetric services for occupational safety,
- calibration and adjustment of instruments for the measurement of ionising radiation (dose-rate and dose).

JSI is authorised by the Ministry of Health for carrying out all measures for the protection against ionising radiation defined in the Act on protection against ionising radiation (Off.Gaz.SRS,9/81), No. of the decision 180-1/80-81, of March 9 1981. Activities of JSI related to the decision are reported in the Chapter 4.4.

9.6.1 MILAN ČOPIČ NUCLEAR TRAINING CENTRE

Activities of the Nuclear Training Centre can be divided into four areas: training of the Krško NPP personnel, training in the area of radiation protection, organisation of international training courses and public information. In the year 2001 the centre continued activities in all four areas.

In the beginning of 2001 the centre concluded the Nuclear Technology course for prospective Krško NPP control room operators. A shorter course Basics of Nuclear Technology for technical personnel of the Krško NPP was also organised. The centre maintained the database for the Commission for Operators Exams. In the area of radiation protection 16 training courses for medical personnel and for industrial use of radioactive sources were organised. The centre organised 11 international training courses under the auspices of the IAEA.

Very successful was the Workshop on Basic and Advanced Reactor Systems. It was organised with the help of professor Andrew Kadak from Massachusetts Institute of Technology in the USA. 23 participants from developing countries attended the workshop.

In the area of public information the centre continued inviting elementary and high schools from Slovenia to visit the information centre. Groups of children were coming to attend lectures on nuclear technology and on radioactive waste, and to visit the exhibition. In the year 2001 there were 7,574 visitors, which was considerably more than the previous year.

9.6.2 DEPARTMENT OF REACTOR ENGINEERING

With regard to research and development activities, the Department was active in the following fields: design-basis accident analyses, severe accident analyses, structural safety analyses and probabilistic safety assessment. Besides working on NEK-specific safety analyses, the Department participated in work on International Standards and in different international projects.

The Department of Reactor Engineering has performed five independent expert evaluations of modification packages and of changes of the NPP Krško Technical Specifications. Within the NPP Krško modernisation project, the evaluation of relevant documents from the supplier firm Westinghouse was completed.

In conformity with the state authorisation for verification of the operational status of the safety systems in a nuclear facility, the following activities were evaluated during the NPP Krško 2001 outage, at the end of the 17th fuel cycle: safety systems testing, measurements of the core power distribution and refuelling.

9.6.3 DEPARTMENT OF REACTOR PHYSICS

In the field of reactor physics, the Department of Reactor Physics focused its research primarily on the development of new computer methods for research and power reactor calculations. The Department continued with the application and verification of the new two-dimensional computer programme for calculating burn up of the fuel of the Research Reactor TRIGA.

As in all previous years since the start of operation of NEK, the Department of Reactor Physics prepared a complete core design, using its own computer code CORD/II. The Department also performed physical tests after the refuelling in NEK.

In 2001 the Department of Reactor Physics prepared a series of expert evaluations which were used by NEK in the licensing processes concerning the completion of plant modernisation. Its work mainly related to the results of the analysis of the third reactor vessel material irradiation surveillance specimen and to the project of reracking of the Spent Fuel Pit. The Department also participated in the preparation of input data for the full-scope plant simulator.

The Department of Reactor Physics participated in five international projects: three within the Fifth Framework Programme of the EU and two of the IAEA. International co-operation was very extensive.

9.7 ENERGY INSTITUTE LTD.

The Energy Institute Ltd. (Institut za elektroprivredu i energetiku d.d., Zagreb - IE) was by decision No. 318-36/4751/AS, issued by the SNSA on 24 August 1993, authorised for the following tasks related to nuclear safety:

quality assurance and quality control of instrumentation and control systems (I&C), and verification of their operability and reliability during the construction, pre-operational tests, trial operation and operation of a nuclear facility.

The activities related to nuclear safety during the 2001 outage in the field of measurement and control systems (I&C area) consisted of inspection control of primary systems according to the Technical Specifications of the Krško NPP. After the outage had been completed, the Energy Institute issued - on the basis of the inspection control – an Expert Assessment of the Outage

Activities, Modifications and Tests during the Shutdown of the Krško NPP for the Outage and Refuelling at the End of the 17th Fuel Cycle in the I&C Domain.

Besides other activities related to QA, the management of the Testing Laboratory of the Institute of High Voltage and Measurements of the IE decided to certify the Laboratory against the standard HRN EN ISO 17025, since HRN EN 45001 had been withdrawn.

9.8 INSTITUTE FOR ENERGY AND ENVIRONMENT PROTECTION -EKONERG

EKONERG (Institut za energetiku i zaštitu okoliša d.o.o. - Zagreb) is, within the area of its expertise, by decision No. 318-36/92-2933/AS issued by the SNSA of 18 June 1992, authorised for the following:

- quality control and quality assurance of mechanical equipment in nuclear facilities and installations during production, installation, pre-operational tests, trial operation and operation,
- performance of acceptance and functional tests of mechanical equipment,
- verification of the baseline condition and periodical in-service inspection of mechanical safety-related equipment.

As an authorised organisation, EKONERG in 2001 participated in the regular outage and refuelling in the Krško NPP. EKONERG performed control of maintenance of the mechanical equipment and valves, as well as heating, ventilation and air-conditioning equipment (HVAC), which were subject of the Technical Specifications. On the basis of inspection of the outage activities, EKONERG prepared an Expert Assessment of the Outage Activities, Interventions and Tests during the Shutdown of the Krško NPP for the Refuelling at the End of the 17th Fuel Cycle.

EKONERG also performed an independent review and evaluation of seven modification packages for the equipment within its expertise.

The other activities of EKONERG related to the permanent training of professionals at seminars and courses, and to co-operation with the IAEA in the field of environmental protection.

9.9 INSTITUTE OF METALS AND TECHNOLOGIES

By decision of the SNSA No. 318-13/94-6906/AS of 18 November 1994, the Institute of Metals and Technologies (IMT), Ljubljana, was authorised for the following expert activities relating to the construction, trial operation, start-up and operation of nuclear facilities and installations:

- quality assurance and control of metals, based on investigations of their chemical, mechanical, microstructural and corrosion properties,
- assurance of quality and adequacy of metals used for metal constructions, piping and pressure vessels.

In 2000 IMT participated as an authorised organisation in the Krško NPP outage and issued an Expert Assessment Report on the Outage Activities, Interventions and Tests during the Shutdown of the Krško NPP for the Refuelling at the End of the 17^{th} Fuel Cycle. In particular, IMT participated in the implementation of the ISI Programme, control of the erosion-corrosion processes, inspection of pressure vessels and inspection of certain bolts important for safety. On the basis of testing IMT issued a report on the testing of a heavy drum for radwaste

In the research field was IMT studying problems of ageing of the two-phase stainless steel, which is important for the operational safety of thermal plants. Its work was presented on several domestic and international professional meetings.

9.10 INSTITUTE OF METAL CONSTRUCTIONS

By decision of the Committee for Energy, Industry and Construction of RS No. 10-034/80 of 8 December 1980, the Institute of Metal Constructions (IMK), Ljubljana is authorised for:

- quality assurance activities,
- measurements, quality control and functioning, including non-destructive testing and quality assurance for bearing metal constructions and metal parts of equipment, pressure piping and vessels during construction, trial operation and operation of nuclear facilities and installations,
- training of technical staff for the above-mentioned tasks.

In 2001, IMK participated as an authorised organisation in the in surveillance of activities during the outage in the Krško NPP in its area of expertise and issued the Expert Assessment of the Outage Activities, Interventions and Tests during the Shutdown of the Krško NPP for the Refuelling at the End of the 17th Fuel Cycle for the areas within the competence of IMK.

IMK also performed a major inspection of bearing steel constructions in NEK, in accordance with the requirements of the Technical regulation for maintenance of steel constructions during exploitation, and performed qualification of welders and welding procedures. In total, 24 joints welded in accordance with specified procedures were examined. The examinations consisted of radiographic control, bending tests and metallographic tests of the welds.

IMK also implemented its QA Programme. The programme was successfully audited by the Slovenian Accreditation and by TUV Bayern Sava.

IMK staff participated in professional meetings and kept in touch with the latest developments in the field of nuclear technology.

9.11 WELDING INSTITUTE

By decision of the Committee of RS for Energy, Industry and Construction (Off. Gaz. SRS, No. 6/82), the Welding Institute, Ljubljana (ZAVAR), was authorised for the following tasks relating to nuclear safety:

- quality assurance activities related to welding,
- quality control of welding,
- verification of welders qualifications, suitability of welding equipment and instrumentation,
- verification of welding-engineering concepts for welded constructions, design and statistics,
- inspection of welds, including non-destructive testing,
- consulting on the use of welding technology in new installations and on its maintenance.

During the 2001 annual outage, ZAVAR controlled welding in the main areas. It performed measurements and tests and supervised the activities of welding and heat treatment, of visual, UT, penetrant and radiographic control of welds, and of pressure tests and functional tests; it also reviewed all related documentation. ZAVAR also reviewed qualification of the welding and QC procedures and performed qualification of welders. Five modifications, implemented during the outage, were also assessed.

Observations based on the supervision of welding are presented in the Expert Assessment of the Outage Activities, Interventions and Tests during the Shutdown of the Krško NPP for the

Refuelling at the End of the 17th Fuel Cycle. The Expert Assessment also contains some recommendations, which are going to be considered by the Krško NPP.

9.12 INSTITUTE OF CIVIL ENGINEERING

The Slovenian National Building and Civil Engineering Institute, Ljubljana (SNBCEI), was by decision no. 390-05/99-1-24127/IG, issued by the SNSA on 20 January 2000 and valid until 1 February 2001 April 1991, authorised for the following tasks and services in the field of nuclear safety on the territory of the Republic of Slovenia:

- control and approval of civil engineering, construction and finalising works in the construction of nuclear facilities,
- performance of constructional and technical monitoring of nuclear facilities in terms of constructional and technical reliability during their exploitation, and
- constructional and technical consulting in the design of nuclear facilities.

In 2001, SNBCEI was the leading partner of the Slovenian PA/SA group (joint venture with the Geological Survey of Slovenia and the University of Ljubljana), performing two studies in the field of performance assessment for a LILW repository.

Besides developmental activities, SNBCEI also performed an analysis of the bearing capacity of the base plaque in the central deposit of radioactive waste at Brinje. The proposed solution was to construct a new plaque over the existing one. At this facility, SNBCEI took part in the quality control in the course of remediation works.

9.13 INSTITUTE OF OCCUPATIONAL SAFETY

The IOS, the Centre of Ecology, Toxicology and Radiation Protection, Ljubljana (IOS), was authorised for the following activities in the field of radiological protection:

- by the Ministry of Health, to implement measures for radiological protection prescribed by the Act on Protection against Ionising Radiation (Off. Gaz. SRS, No. 9/91), Decision No. 180-1/80-81 of 9 March 1981,
- by a decree from the Federal Committee for Work, Health and Social Care (SFRY), to perform systematic research of radioactive contamination (Off. Gaz. SFRY, No. 40/86),
- by a decree from the Committee of RS for Health and Social Care it was appointed as an authorised organisation to perform radiological contamination control of food of animal and vegetable origin (Off. Gaz. SRS, No. 25/89),
- in the area of ecology and toxicology, for expert tasks relating to occupational safety (Off.Gaz. SRS, No. 22/87).

In 2001 IOS was active as an authorised organisation and as a research unit for surveillance and control of radioactive contamination of the living and working environment in Slovenia.

Its report is presented in Chapter 4.3.

9.14 CONCLUSIONS

Technical support organisations represent a vital part in surveillance of operations, back fitting, modifications and maintenance work in nuclear facilities. The work of technical support organisations supplements the work of the Nuclear Safety Inspection, which has insufficient manpower to cover all the activities in the nuclear facilities relating to nuclear safety.

The report of the technical support organisation shows that the major part of their work covers surveillance of annual outage and refuelling. With the replacement of steam generators, the duration of annual outage will be shorter, and the Inspectorate and the technical support organisations should be prepared accordingly. A shorter outage will require better planning of surveillance activities, as well as better co-ordination and co-operation between the Krško NPP, the Inspection and the technical support organisations.

The report also shows that the technical support organisations are active in research and development, and that they take care of regular training of their personnel in the fields within their responsibility. Very important is also the organisation of quality assurance, which is also verified by the SNSA.

10 LIABILITY INSURANCE FOR NUCLEAR RISKS - NUCLEAR POOL

The pool for insurance and reinsurance of nuclear risks is a special type of insurance company, whose priority is insurance and reinsurance of nuclear risks. On March 22, 1994, all major Slovenian insurance companies (Triglav, Maribor, Adriatic, Tilia, Slovenica, Mercator, Merkur) and the reinsurance company Sava, signed a Contract on the formation of a Nuclear Pool, and on April 1, 1994, the Nuclear Pool started to run its business operations. The head office is located at the Triglav Insurance Company, Miklošičeva 19, Ljubljana. It operates on the basis of a licence by the Ministry of Finance of March 17, 1994 (Decree No. 301-13/94). Since the year 2000, there are nine (9) members of the Nuclear Pool, including Triglav RE, Reinsurance Company Ltd., which joined the pool in 2000. The Insurance Company Triglav and the Reinsurance Company Sava have the major shares in insurance and reinsurance activities of the Pool. In 2001, the Nuclear Pool operated with the same capacities as in the previous year, when the Pool members decided to increase the capacities for domestic risks from USD 5,600,000 to USD 6,620,000, and foreign risks from USD 4,550.000 to USD 5,960,000.

In former Yugoslavia, the Nuclear Power Plant Krško was fully insured by the Croatian Nuclear Pool. When Slovenia and Croatia became independent countries, a decision was reached that both pools co-insure the NPP Krško up to 50% each. For the period from 6 May 2001 to 5 May 2002, two individual policies were issued for property damage and third party liability insurance. The annual limit for the fire property damage and machinery breakdown insurance amounted to USD 800 million. Both pools and the NPP Krško retained a share of 2 %, while the rest of the risk is insured by twenty-two (22) foreign pools, the most important being British, Japanese, German and French.

The Third Party Liability cover is insured by the Slovenian Nuclear Pool only. The limit of indemnity amounts to USD 42.0 million, in accordance with the Slovenian legislation. From January 1, 2002, to May 5, 2002, this cover was brought into line with the new Government Decree (Official Gazette I. No. 110 dd. December 29, 2001) according to which the increased limit of indemnity amounted to SDR 150 million, or (in US$ on the day when an Annex to the existing Policy For TPL Insurance was concluded), it amounted to US$ 190,007,000. The share retained by our pool amounted to 3.80 %, the rest of the risk was insured by eighteen (18) foreign pools.

It should be noted that the Nuclear Power Plant Krško reported no loss in the year 2001.

Slovenian Nuclear Pool members and their shares in insurance of domestic and foreign risk are given in Table 10.1.

Table 10.1: Slovenian Nuclear Pool members and their shares in insurance of domestic and foreign risk.

Members	Insurance of NPP Krško		Reinsurance of foreign risks	
	USD	Share in [%]	USD	Share in [%]
Ins. Co. Triglav, Ltd.	3,523,902	53,23	3,185,072	53,44
Reins. Co. Sava, Ltd.	786,910	11,89	712,228	11,95
Reins. Co Triglav Re, Ltd.	161,490	2,44	153,570	2,58
Ins. Co. Maribor, Ltd.	630,532	9,52	570,145	9,57
Ins. Co. Adriatic, Ltd.	551,840	8,34	498,801	8,37
Ins. Co. Tilia, Ltd.	358,000	5,41	291,200	4,88
Ins. Co. Slovenica, Ltd.	413,619	6,25	373,043	6,26
Ins. Co.Krekova, Ltd.	129,138	1,95	117,294	1,97
Ins. Co. Merkur, Ltd.	64,569	0,97	58,647	0,98

Total	6,620,000	100.00	5,960,000	100.00

11 POOL FOR DECOMMISSIONING OF THE KRŠKO NPP AND FOR RADWASTE DISPOSAL FROM THE KRŠKO NPP

In the year 2001, 3,941 million SIT was paid by the Krško NPP in order to fulfil all obligations emanating from nuclear energy production. At the end of 2001, the Pool for the decommissioning of the Krško NPP and for radwaste disposal from the Krško NPP had financial investments amounting to 15,426 million SIT. The financial assets of the pool amounted to 1,620 million SIT.

11.1 THE FULFILMENT OF LEGAL OBLIGATIONS OF THE KRŠKO NPP FROM THE TITLE OF CONTRIBUTIONS TO DECOMMISSIONING

Since 20 June 2000, the Krško NPP has been regularly fulfilling its financial obligations, both current and agreed obligations from the past. Table 11.1 shows all monthly payments in 2001.

Table 11.1: Review of payments of the Krško NPP in 2001.

Month	Payments in [SIT]
January	484,393,409.90
February	481,756,509.00
March	448,371,833.20
April	476,389,888.60
May	428,511,512.00
June	57,373,977.00
July	101,874,331.00
August	294,752,671.00
September	272,605,584.00
October	290,678,054.00
November	307,035,448.00
December	297,121,911.00
Total	3,940,865,128.70

The monthly payments include regular contribution for the electric energy, delivered to the Slovenian electric company, expired debts regulated by Settlement I, and (before 20 May 2001) also the expired instalments by Agreement IV and the Annex to it, and the overdue interests by Agreement IV and the Annex to it.

Of the total sum of 3,940.8 million SIT: 829 million SIT was paid for the obligations expired between 1997 and 2000, 2,336.4 million SIT was the regular contribution, 748.5 million SIT was paid for the obligations expired between 1995 and 1996, 26.9 million SIT was payment of overdue interests. Table 11.2 shows the cumulative payments and long-term obligations of the NPP in the period 1995 - 2001.

Table 11.2: Payments and long-term obligations of the Krško NPP.

Period	Payments in [000 SIT]	Total debt in [000 SIT]
1995	0	2,971,316
1996	200,000	6,581,636
1997	698,778	8,645,093
1998	1,864,905	9,699,883
1999	2,226,999	10,452,197
2000	3,869,046	9,943,811
2001	3,940,865	9,453,527
Total	12,800,593	9,453,527

Table 11.2 also shows that between 1996 and the end of 2001, the Krško NPP paid to the pool a total amount of 12,800 million SIT for decommissioning.

On 31 December 2001, the total debt of the Krško NPP reached 9,454 million SIT. The Krško NPP obligations from the title of electric energy delivered to the Croatian electric company reached 9,038 million SIT, of which 3,695 million SIT were overdue interests.

The obligations from the title of electric energy delivered to the Slovenian electric company reached 416 million SIT, and will be paid in the first half of 2002.

If the contract between Slovenia and Croatia about the settlement of statutory and other legal relations, connected to the investments into the Krško NPP, its exploitation and decommissioning is ratified, all the Krško NPP obligations to the pool will be cancelled. In the opposite case, the pool will try to reach an agreement on the payment of the expired obligations.

11.2 INVESTMENT POLICY IN THE YEAR 2001

In the year 2001, the pool followed the principles of safe investing and dispersion. The pool accordingly had at least 30% of financial investment in government stocks. These stocks were issued and guaranteed by the Republic of Slovenia.

On 31 December 2001, the pool had 15,415 million SIT of financial investments. The structure of the investments was: 68% of assets was invested in the form of deposits, 32% were governmental stocks (domestic and EURO shares) and 0.034% were in other shares. The investments in governmental stocks were dispersed in eleven different editions, and investments in deposit were dispersed in nine commercial banks.

In 2001, the profit of the portfolio of the pool was TOM+5.53% or EUR+8.59%. In the same year, the pool made 1,620 million SIT of financial assets with investments.

Figure 11.1 shows the financial situation of investments of the pool from 1996 to the end of 2001. A steep increase in financial assets can be seen, which derives from regular contributions to the fund and successful investment policy. In 2001, the financial assets rose by 53% in comparison with 2000. The biggest increase of financial assets, however, occurred in 2000 in comparison with 1999, namely 129%.

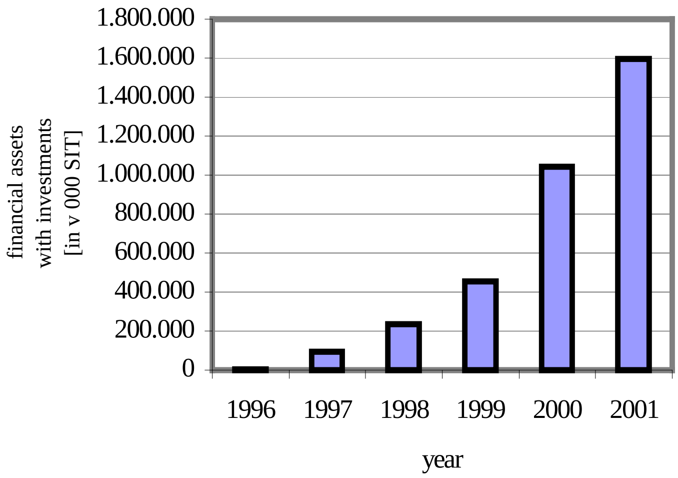

Figure 11.1: Financial assets with investments from 1996 to 2001.

Source:

- Information on the financial status of the pool in the year 2001, prepared by the pool.

12 OPERATION OF NUCLEAR FACILITIES WORLD-WIDE

12.1 REVIEW OF NUCLEAR POWER PLANTS WORLD-WIDE

According to information provided by the International Atomic Energy Agency, at the end of 2001 there were 440 nuclear power plants in operation in 30 countries plus Taiwan, which is two units more than in 2000. The overall nuclear capacity was 353 GW. In 2001, two new nuclear power plants were connected to the grid, one of them in Japan and one in Russia.

At present, 32 nuclear power plants are under construction. In 2001, the share of electrical energy supplied from nuclear power plants was still considerably high and presented about 16% of the world's electrical production. The ten countries with the world's highest national contribution of nuclear energy are: France 76.5%, Lithuania 73.7%, Belgium 56.8%, Slovakia 53.4%, Ukraine 47.3%, Bulgaria 45%, Republic of Korea 40.7%, Hungary 40.6%, Sweden and Slovenia 39%. 17 countries and Taiwan relied on nuclear power plants to meet at least 25% of their total electricity needs, including Slovenia. The cumulative world-wide operation of nuclear power plants at the end of 2001 exceeded 10,000 reactor years. Geographically, the number of the existing nuclear power units is as follows: North America 118 units, South America 6 units, Western Europe 150 units, Central/Eastern Europe and Newly Independent States 69 units, Middle East, Far East and South Asia 99 units, and Africa 2 units. Number of nuclear power units in operation and under construction at the end of 2001 by countries, with total nuclear output and share in total electricity production are given in Table 12.1.

Table 12.1: Number of nuclear power units in operation and under construction at the end of 2001 by countries, with total nuclear output and share in total electricity production.

Country	Reactors		Output	
	Operation	Construction	Energy [TWh]	Share [%]
Argentina	2	1	5.7	7.3
Armenia	1		1.8	33.0
Belgium	7		45.4	56.8
Brazil	2	-	6.0	1.9
Bulgaria	6		18.2	45.0
Canada	14		68.7	11.8
China	3	8	16.0	1.2
Czech Rep.	5	1	13.6	20.1
Finland	4		21.6	32.2
France	59		395.0	76.4
Germany	19		159.6	30.6
Hungary	4		14.2	40.6
India	14	2	14.2	3.1
Iran		2		
Japan	54	3	304.9	33.8
Korea, R. of	16	4	103.5	40.7
Lithuania	2		8.4	73.7
Mexico	2		7.9	3.9
Netherlands	1		3.7	4.0
Pakistan	2		1.1	1.7
Romania	1	1	5.1	10.9
Russia	30	2	119.7	15.0
South Africa	2		13.0	6.6
Slovak Rep.	6	2	16.5	53.4

Slovenia	1		5.0	38.98
Spain	9		59.3	27.6
Sweden	11		54.8	39.0
Switzerland	5		25	38.2
UK	35		78.3	21.9
Ukraine	13	4	72.4	47.3
USA	104		753.9	19.8
Total*	440	32	2449.4	

Source:

– IAEA, Nuclear Technology Review 2002, GOV/2002/7

* Total includes Taiwan

12.2 NUCLEAR SAFETY WORLD-WIDE

12.2.1 IAEA MISSIONS

By the end of the year 2001, the IAEA had 133 members; in addition, 58 governmental and non-governmental organisations had agreements and arrangements with the IAEA. The IAEA continued to play an important role under the three pillars of its mandate – technology, safety and verification. It continued with its activities in archiving and maintaining a high level of safety of nuclear installations operating world-wide through harmonisation of safety standards and norms and provisions of advice and services.

The IPSART Mission (*International Probabilistic Safety Analysis Review Team*) performed 5 Probabilistic Safety Analyses and one pre-IPSART mission. All IPSART Missions are listed in Table 12.2. As stated in the Table 12.3, the first RAMP mission (*Review of Accident Management Programme*) was conducted in Slovenia. The work of the working commission of the IAEA, called OSART (*Operational Safety Assessment Review Team*), which performed 7 missions in the year 2001, is seen in Table 12.4.

The meetings and workshops under the PROSPER mission (*Peer Review of Operational Safety Performance Experience*) are listed in Table 12.5.

The Safety Culture Enhancement Programme (SCEP) missions are presented in Table 12.6. The technical safety reviews under the ESRS mission (*Engineering Safety Review Services*), concerning design and site safety, were performed at 12 locations. The list of nuclear installations is given in Table 12.7. The safety reviews of research reactors under the INSARR mission (*Integrated Safety Assessment of Research Reactors*) are listed in Table 12.8. And the IRRT missions (*International Regulatory Review Team*) in 2001 are listed in the Table 12.9.

Table 12.2: International Probabilistic Safety Analysis Review Team (IPSART) in the year 2001.

Review type	Country	Nuclear power plant
Level 1 follow-up and level 2 PSA	Lithuania	Ignalina
Level 1 PSA	Pakistan	KANUPP
Level 1 pre-IPSART	Romania	Cernavoda
External events and level 2/3 PSA	Russian Federation	Novovoronezh, unit 5
Level 1 PSA and hazards	Slovakia	Mochovce
Level 1 PSA	Ukraine	Zaporozhe

Table 12.3: Review of Accident Management Programme (RAMP) in the year 2001.

Type	Country	Location
Pilot RAMP	Slovenia	Krško

Table 12.4: Operational Safety Assessment Review Team (OSART) in year 2001.

Type	Country	Nuclear power plant type
Preparatory meeting	Brazil	Angra 2 PWR
OSART – follow-up	Bulgaria	Kozloduy VVER
Preparatory meeting	Canada	Pickering PHWR
Pre-OSART	China	Lingao PWR
Full OSART	Czech Republic	Dukovany VVER
Full OSART	Czech Republic	Temelin VVER
Full OSART	Hungary	Paks VVER

Table 12.5: Peer Review of Operational Safety Performance Experience (PROSPER) in 2001.

Type	Country	Plant/location
Introductory mission	Armenia	Metsamor
Assistance mission	Pakistan	Karachi
Preparatory meeting	Romania	Cernavoda
Workshop	Russian Federation	Bilibino
Seminar	Russian Federation	VNIIAES

Table 12.6: Safety Culture Enhancement Programme (SCEP) in 2001.

Type	Country	Location/nuclear power plant
SCEP workshop	Brazil	INB, Rio de Janeiro
Workshop for managers	Brazil	Angra dos Reis
Self-assessment workshop	Brazil	INB, Angra dos Reis
Regional workshop	China	Santiago de Chile
Regional workshop	China	Daya Bay
Safety culture seminar	France	INSTN, Saclay
Self-assessment workshop	Mexico	Laguna Verde
Workshop	Russian Federation	Volgodonsk
Safety culture seminar	Slovakia	Slovak Technical University
Regional workshop	Slovakia	Piestany
Presentation on management of safety	Sweden	SGS, Stockholm
Seminar on management of safety	Sweden	Stockholm

Table 12.7: Engineering Safety Review Service (ESRS) Missions in 2001.

Service	Country	Site/plant
Ageing safety review	Armenia	Medzamor
Seismic safety review follow-up	Armenia	Medzamor
Site safety review	Bangladesh	Rooppur
Periodic safety review	China	Qinshan
Design safety review	China	Taiwan
Review of Agency safety issues	Czech R.	Temelin
PSAR review assistance	Is. R. of Iran	Bushehr
Design safety review	R. of Korea	Korean Next Generation Reactors
Documentation review on severe accident safety features	China	Taiwan

PSAR review	Is. R. of Iran	Busher
Periodic safety review	Slovenia	Krško
Seismic safety review	Turkey	Istanbul

Table 12.8: Integrated safety of research reactors (INSARR) missions in 2001.

Type	Country	Research reactor
Pre – INSARR	Bangladesh	3MW TRIGA MARK II
Pre – INSARR	Chile	La Reina RR
Pre – INSARR	China	SPR, NHR, HTR-10
Pre – INSARR	Greece	GRR-1
INSARR	Greece	GRR-1
Pre – INSARR	Islamic. R. of Iran	TRR-1
Pre – INSARR	Romania	14 MW TRIGA MARK II
Pre – INSARR	Syrian Ar. R.	MNSR RR

Table 12.9: International Regulatory Review Team (IRRT) missions in 2001.

Type	Country
Full scope	Czech Republic
Full scope	Lithuania
Full scope	Mexico
Pre-IRRT	Thailand
Full scope follow-up	Ukraine

12.2.2 PROGRAMS OF THE IAEA

The programs of the IAEA are focused on the use of nuclear energy for peaceful purposes, as indicated in Table 12.10. The funds are mostly allocated for disease prevention and health care, food production in agriculture and for applications of the physical and chemical science.

Table 12.10: Technical Co-operation Disbursements by Agency Programs and Regions in 2001. (in thousands of dollars)

Programme	US Dollars
Nuclear Power	3.9
Nuclear Fuel Cycle and Waste Management Technology	3.3
Comparative Assessment for Sustainable Energy Development	0.8
Food and Agriculture	12.2
Human Health	16.9
Marine Environment and Water Resources	4.8
Application of Physical and Chemical Science	10.6
Nuclear Safety	4.8
Radiation Safety	8.4

12.2.3 INES- INTERNATIONAL NUCLEAR EVENT SCALE

The IAEA information system - the International Nuclear Event Scale (INES) received 23 reports in 2001. Fifteen reports were on events in nuclear power plants, the remaining 8 on lost radioactive sources (3 reports), on radioactive events (3 reports) and on the transport of radioactive substances (2 reports). Six events in nuclear power plants were of the second degree – »incident«, four of the first degree »anomaly« and five were below scale – »no safety significance«. Among other events, two were of the second degree, five of the first degree, and one event was below scale. Slovenia made no reports to the INES Scale, since there were no accidents, incidents or other events related to nuclear or radioactive materials.

In 2001, a new internet information system called NEWS began its trial operation. NEWS system is a protected communication system for quick transfer of information among regulatory bodies, operators and technical support organisations. The system is jointly operated by the IAEA, OECD/NEA and WANO. NEWS submits data, which could draw attention of the media. The system has its own password and various levels of access for experts form regulatory bodies and nuclear utilities or other users of nuclear energy, i.e. journalists or general public.

12.2.4 IMPORTANT ABNORMAL EVENTS IN NUCLEAR POWER PLANTS IN 2001

Within the framework of IAEA IRS »Incident Reporting System« the SNSA actively participates in the exchange of information on abnormal events in nuclear power plants in the world.

A SNSA representative attends the annual meetings of national co-ordinators for the exchange of information on abnormal events in nuclear power plants. More important events in 2001 were the following:

- Davis Besse - 1 NPP (USA, PWR, Babcock & Wilcox Co., electric power 873 MW, commercial operation 1978: During the annual outage a severe reactor head degradation was revealed at control rod drive mechanism nozzle (CRDM nozzle) due to leakage of primary coolant and subsequential boron corrosion (significant loss of metal approximately 17 kilos of ferritic steel). The degradation could cause a Loss of Coolant Accident. Open questions of used materials were discussed as well as in service inspections of reactor vessel head and management of NPP. New researches on erosion and corrosion and influence on boron acid on used materials.

- Brunsbuettel NPP (Germany, BWR, Siemens Kraftwerk Union AG, electric power 771 MW, commercial operation 1977): During the operation in full power operators noticed a small leak inside containment that was manually isolated. After inspection of the location it was detected that 2.7 m of the reactor pressure vessel head spray line was totally ruptured. The event sequence was not fully understood, the main cause seemed to be a radiolysis gases explosion inside the piping. A similar event happened at the Hamaoka – 1 NPP, which has been still investigated by representatives of the German and Japanese regulatory bodies. There were no consequences to the environment and plant personnel.

- Hamaoka – 1 NPP (Japan, BWR, Toshiba Corporation, electric power 540 MW, commercial operation 1976): in full power operation experienced steam leakage due to pipe rupture of Residual Heat Removal (RHR) system-steam condensing mode line branching from HPCI system when High Pressure Coolant Injection (HPCI) turbine was just started for the periodic manual-start-up-test. Steam leakage was ceased approximately 30 seconds after the rupture, because of automatic isolation of the pipe line including, the ruptured point, from the main steam line. The reactor was manually shut down. There was no release of radioactive material to the environment.

- Philippsburg – 2 NPP (Germany, PWR, Siemens Kraftwer Union AG, electric power 1392 MW, commercial operation 1985): At the end of the annual outage in 2001, all four refuelling water storage tanks (RWSTs each of 50% of design capacity) were not completely filled. In accordance with technical specifications operators started filling them up. Due to valve mispositioning they were filled up with demineralised water instead with borated water (2000 ppm). Boron concentration below technical specifications was noticed by the operators, about two weeks after start up in one RWST. The correct boron concentration in all four RWSTs was reached in about four weeks after start up. Following the analysis of the event the licence revealed that from the beginning of the commercial operation too low boron concentration in RWSTs occurred sixteen times. The event mentioned above did not have any consequences, but serious deficiencies in safety management were pointed out.

- Flamanville – 2 NPP (France, PWR, FRAMATOME, electric power 1330 MW, commercial operation 1987): Loss of control system, reactor coolant pump trip and rector scram occurred due to incorrect maintenance of inverters (replacement of capacitors). Power supply of one emergency bus was interrupted (one CVCS chemical and volume control system pumps tripped main generator seal oil pump tripped). Due to main generator seal oil pump trip, main generator hydrogen leak occur and turbine hall evacuation was disclosed. Six hours after the event, the plant was stabilised and cool down of the plant began. Core damage frequency to 10E-5 was estimated. There were no consequences for the environment and plant personnel.

- Kruemmel NPP (Germany, BWR , Siemens Kraftwerk Union AG, electric power 1260 MW, commercial operation 1984): A fuel element stuck to the neighbouring fuel element during the refuelling outage. The fuel deloading process was automatically stopped at the moment the stacked fuel elements were approximately 80 cm below the top of the core. At this point of operation the second fuel element fell back into the core. The defiling device was not equipped with a over load protection device. During the event no fuel element was damaged and no radioactive release occurred. There were no consequences for the environment and plant personnel.

- Dampierre – 4 NPP (France, PWR, FRAMATOME, electric power 890MW, commercial operation 1981): The NPP staff started the reactor core loading, inserting 157 fuel elements into the reactor. At inserting the 25th element, the personnel's communication was false. Due to this fact, the fuel element No. 25 remained in the spent fuel pit, while the fuel element No. 26 was inserted into the position 25 in the reactor vessel. Later on at inserting the fuel element No. 38 the personnel recognised the fault. The fuel element No. 25 had lower weight compared to the fuel element No. 26, which was also equipped with control rods, however that was not observed on the loading device. There were no consequences, but the event indicated serious weaknesses at ensuring nuclear safety.

Furthermore, it should be stated that in the past three years the Krško NPP (PWR, Westinghouse, electric power 707 MW, commercial operation 1981) operated steadily, there were no abnormal events, which should be reported within the frame of the system mentioned above.

13 ABBREVIATIONS

13.1 KRŠKO NPP SYSTEMS

The abbreviations used for the Krško NPP are given in Table 13.1.

Table 13.1: Abbreviations used for the Krško NPP.

AF	AUXILIARY FEEDWATER
AS	CONTROL BOARD AND COMPUTER SYSTEM
BD	STEAM GENERATOR BLOWDOWN SYSTEM
BR	BORON RECYCLE SYSTEM
CA	COMPRESSED AIR SYSTEM
CA	STATION SERVICE AIR (SECONDARY)
CB	CONTROL BOARD SYSTEM
CC	COMPONENT COOLING SYSTEM
CF	CHEMICAL FEED SYSTEM
CI	CONTAINMENT SPRAY SYSTEM
CK	CONDENSATE POLISHING SYSTEM
CO	CONDENSER & ACCESSORIES
CP	ROD CONTROL AND POSITION
CS	CHEMICAL & VOLUME CONTROL SYSTEM
CT	COOLING TOWER
CU	COMPUTER SYSTEM
CV	CONDENSER AIR REMOVAL SYSTEM
CW	CIRCULATING WATER SYSTEM
CX	CONTAINMENT TESTING & PRESSURIZING SYSTEM
CY	CONDENSATE SYSTEM
CZ	CHILLED WATER SYSTEM
DC	DC POWER SUPPLY & DISTRIBUTION
DD	DEMINERALIZED WATER SYSTEM
DF/DO	DIESEL OIL STORAGE SYSTEM
DG	DIESEL GENERATOR SYSTEM
DR	FLOOR AND EQUIPMENT DRAINS
EE	ELECTRICAL SYSTEM
EI	ELETRICAL INTERCONNECTIONS
EP	ELECTRICAL SYSTEM (BOP, AC & POWER SUPPLY)
ER	ENVIRONMENTAL MONITORING SYSTEM
ES	ELECTRICAL MISCELLANIOUS A. C. DISTRIBUTION
EX	EXTRACTION STEAM SYSTEM
FC	FEEDWATER CHEMICAL ADDITION
FD	FLOOR & EQUIPMENT DRAINS
FH	FUEL HANDLING SYSTEM
FO	FUEL OIL TRANSFER

FP	FIRE PROTECTION SYSTEM
FW	FEEDWATER SYSTEM
GH	WASTE PROCESSING GAS SYSTEM
GN	MAIN GENERATOR & ACCESSORIES
HC	H_2 CONTROL & MONITORING
HD	HEATER DRAIN SYSTEM
HS	AUXILIARY STEAM HEATING SYSTEM
HT	PIPE HEAT TRACING
HW	HOT WATER SYSTEM
IA	INSTRUMENT AIR
IC	IN-CORE INSTRUMENTATION SYSTEM
IN	INSTRUMENT & CONTROL
LO	TURBINE LUBE OIL SYSTEM
LS	LIGHTING & UTILITY POWER SYSTEM
ME	MISCELLANEOUS EQUIPMENT – NUCLEAR
MP	MECHANICAL EQUIPMENT – SECONDARY
MS	MAIN STEAM
MT	MISCELLANEOUS TOOLS, MACHINES & APPLIANCES
MW	REACTOR MAKEUP WATER SYSTEM
NI	NUCLEAR INSTRUMENTATION
PC	PHONE & COMMUNICATION
PG	PLANT GAS SUPPLY SYSTEM (O, N, H, CO_2, CL)
PW	PRETREATMENT WATER
RC	REACTOR COOLANT SYSTEM
RD	RIVER DAM
RH	RESIDUAL HEAT REMOVAL SYSTEM
RM	RADIATION MONITORING SYSTEM
SA	AUXILIARY STEAM SYSTEM
SC	STEEL CONTAINMENT SYSTEM
SD	STEAM DUMP CONTROL
SE	SECURITY SYSTEMS
SF	SPENT FUEL PIT COOLING & CLEANUP
SF	SPENT FUEL POOL LEAK DETECTION & SKIMMER
SF	SPENT FUEL PIT (vent & drain)
SG	SAFEGUARDS ACTUATION
SI	SAFETY INJECTION SYSTEM
SS	SAMPLING SYSTEM (NUCLEAR)
SW	SERVICE WATER
SX	TURBINE PLANT SAMPLING SYSTEM
TC	TURBINE PLANT AUX. COOLING WATER
TD	TURBINE DRAINS
TG	TURBINE GLAND STEAM
TR	THERMAL REGENERATION SYSTEM

TS	SG TEST PROGRAM
TU	MAIN STEAM TURBINE ACCESSORIES
VA	VENTILATION & A/C
VC	VACUUM PRIMING SYSTEM
VM	VIBRATION MONITORING SYSTEM
VP	TB VENTILATION & AIR CONDITIONING SYSTEM
WC	WIRE WAY & CONDUIT
WD	WASTE DISPOSAL SYSTEM
WP	LIQUID WASTE PROCESSING SYSTEM
WS	REFUELING WATER STORAGE TANK HEAT & PURIFICATION
WT	WATER TREATMENT SYSTEM
XI	PROCESS INSTRUMENTATION & CONTROL
XR	TRANSFORMER SYSTEM

13.2 OTHER ABBREVIATIONS

The most common abbreviations used in Slovenian and foreign literature are given bellow. The abbreviation Z1 to Z2 are taken from *Varstvo okolja pred ionizirajočimi sevanji*, Zbirka zveznih predpisov Jugoslavije, ed. Miha Trampuž, Ljubljana 1989, Zavod SR Slovenije za varstvo pri delu, Ljubljana.

ADR	The European Agreement concerning the International Carriage of Dangerous Goods by Road
ALARA	As Low As Reasonably Achievable
ARAO	Agency for Radioactive Waste Management
BSS	Basic Safety Standard
BWR	Boiling Water Reactor
CONCERT	Concentration on European Regulatory Tasks
CROSS	Central Slovenian radiation warning system
CTBT	Comprehensive Nuclear-test-ban Treaty
DBE	Deütsche Gesellschaft zum Bau und Betreib von Endlagen für Abfallstoffe GmbH
DFBN	Debris Filter Bottom Nozzle
EAEC	European Atomic Energy Community
ECURIE	European Community for Urgent Radiological Information Exchange
EFPY	Effective Full Power Years
EIMV	Milan Vidmar Electrical Institute
ELME	Ecological Laboratory with a Mobile Unit
ERDS	Emergency Response Data System
ESRS	Engineering Safety Review Services
EU	European Union
EURDEP	European Union Radiological Data Exchange Platform
FER	Faculty of Electrical Engineering and Computing
FRI	Fuel Reliability Data Indicator
FS	Faculty of Mechanical Engineering
GZL	Geološki zavod Ljubljana
HEPA	High Efficiency Particulate Air
HIRS	Health Inspectorate of the Republic of Slovenia
HMJ Boršt	Hidrometalurška jalovina na Borštu
HMZ	Hidrometalurški zavod

HTGR	High Temperature Gas Reactor
IAEA	International Atomic Energy Agency
ICISA	International Commission for Independent Safety Assessment
ICJT	Milan Čopić Nuclear Training Centre
ICRP	International Commission for Radiation Protection
IDDS	In-drum Drying System
IEE	Energy Institute Ltd.
IGGG	Inštitut za geologijo, geotehniko in geofiziko
JSI	Jožef Stefan Institute
IMK	Institute of Metal Construction,
IMT	Institute of Metals and Technologies
INES	International Nuclear Event Scale
INEX	International Nuclear Exercise
INPO	Institute for Nuclear Power Operation
INSARR	International Safety Assessment of Research Reactors
IMPDŠ	Institute of Occupational, Traffic and Sports Medicine
IPSART	International Probabilistic Safety Analysis Review Team
IRGO	Inštitut za rudarstvo geotehnologijo in okolje
IRRT	International Regulatory Review Team
ISEG	Independent Safety Evaluation Group
ISI	In-service Inspection
ISO	International Standard Organisation
ISOE	International System on Occupational Exposure
IV	Welding Institute
KNM	Department of Nuclear Medicine of the Medical Centre Ljubljana
KC	Medical Centre Ljubljana
KJV	Convention of Nuclear Safety
LBB	Leak Before Break
LCO	Limiting Condition for Operation
LED	Annual Effective Dose
MAAE	International Atomic Energy Agency
MCB	Main Control Board
MCR	Main Control Room
MEOR	Ministry of Economy
MF	Ministry of Finance
MNZ	Ministry of the Interior
MOP	Ministry of Environment and Spatial Planning
MPZ	Ministry of Transport
MZ	Ministry of Health
MZT	Ministry of Science and Technology
NEK	Krško NPP
NE Krško	Krško NPP
NEK-STS	Technical Specification of the Krško NPP
NFPA	National Fire Protection Agency
NIS	Newly Independent States
NRC	Nuclear Regulatory Commission
NSG	Nuclear Suppliers Group
NSRAO	Low and Medium Radioactive Waste
NU	Emergency Operating Procedure
NRWG	Nuclear Regulatory Working Group
OECD/NEA	Organisation for Economic Co-operation and Development/Nuclear Energy Agency
OI	Institute of Oncology
OSART	Operational Safety Assessment Review Team
OZN	United Nations Organisation

PAEC	Short-Lived Radon Progeny
PET	Positron Emission Tomograph
PHARE	Central and Eastern European Countries Assistance for Economic Restructuring
PIS	Process Information System
Program TMI	Three Mile Island Program
PROSPER	Peer Review of Operational Safety Performance Experience
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
PWR	Pressurised Power Plant
QA	Quality Assurance
RAMG	Regulatory Assistance Management Group
RAMP	Review of Accident Management
RAO	Radioactive Waste
RB	Reactor Building
RBMK	Graphite Moderated Reactor – Russian Type
RCP	Reactor Coolant Pump
RH	Republic of Croatia
RKB	Radiological, Chemical, Biological
RS	Republic of Slovenia
RSCM	Mežica Lead and Zinc Mine
RTD	Resistance Thermal Detector
RTG	Roentgen Apparatus
RTP	Razdelilna transformatorska postaja
RŽV	Rudnik Žirovski vrh p.o.
RUŽV	Žirovski vrh Mine
SCEP	Safety Culture Enhancement Programme
SIQ	Slovenian Institute of Quality
SKJV	Strokovna komisija za jedrsko varnost
SKPUO	Strokovna komisija za preizkus znanja usposobljenosti operaterjev NEK
SNBEIC	Slovenian National Building and Civil Engineering Institute
SR	Surveillance Requirements
SSPS	Solid State Protection System
ŠCZ	Civil Protection Headquarters
TE	Thermal Power Plant
TLD	Thermoluminiscent Dosimeter
TL	Thermoluminiscent
TRIGA	Training Research Isotope General Atomic
TTC	Tube Type Container
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
Ur.l.	Official Gazette
URSG	Uprava Republike Slovenije za geofiziko
URSJV	Slovenian Nuclear Safety Administration
URSZR	Administration for Civil Protection and Disaster Relief
US NRC	United States Nuclear Regulatory Commission
VVER	PWR – Russian Type
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association
WHO	World Health Organisation
SNBCEI	Slovenian National Building and Civil Engineering Institute
ZIRS	Health Inspectorate of the Republic of Slovenia
ZN	United Nations
IOS RS	Institute of Occupational Safety
ZVISJE	Zakon o varnosti pred ionizirajočimi sevanji in o posebnih varnostnih

ukrepih pri uporabi jedrske energije